European Commission

The economic impact of enforcement of competition policies on the functioning of EU energy markets

Non-technical Summary and Technical report

Competition

EUROPEAN COMMISSION

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Luxembourg: Publications Office of the European Union, 2016

Catalogue number: KD-02-16-007-EN-N

ISBN 978-92-79-54567-2
doi: 10.2763/55423

The economic impact of enforcement of competition policies on the functioning of EU energy markets

European Commission, Directorate-General for Competition

Specific contract no. COMP/2014/003 implementing Framework Contract ECFIN-005-2011/LOT NO.1

A Report Submitted by ICF Consultancy Services in association with DIW Berlin

Non-technical Summary

16 November 2015

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Abstract

This study examines whether EU competition policy enforcement has led to stronger competition in European gas and electricity markets and hence lower prices, higher investment and improved productivity. Specifically, the study analyses the impact of competition policy enforcement on short-run measures of intensity of competition such as profit elasticity and productivity dispersion (at sector-country level); and medium and long-term competitive outcomes such as investment and productivity (at firm-sector-country level). The main result of this analysis is that EU merger policy enforcement is consistently and significantly related to better market outcomes, especially in low-regulated markets. The impacts of the EU's anti-trust enforcement and state aid control on the other hand, are not statistically significant.

The study also empirically evaluates the price effects of two individual competition policy enforcement cases using the Difference-in-Differences (DiD) approach.

The first case study analyses the impact of the Commission's case against E.ON (2008) for its alleged abuse of dominant position in the German wholesale electricity market. Specifically, this case study examines the impact of the Commission's Decision on wholesale electricity prices, using daily data on peak and off-peak prices from the European Energy Exchange (EEX). The results show that the Commission's Decision, by affecting competition in the EEX, led to a reduction in wholesale electricity prices in Germany. To determine whether wholesale price reductions were eventually passed on to consumers by electricity suppliers, we further analysed retail electricity prices using highly disaggregated data (monthly data at zip code level) purchased from the German price comparison website Verivox. The results suggest that the Commission's Decision – by reducing market power upstream and thereby lowering wholesale prices – might have also contributed to reducing prices downstream.

The second case study examines the price effects of the Gaz de France (GDF)-Suez merger, approved by the European Commission in November 2006. The results show that the merger and associated remedies had a significant downward impact on wholesale gas prices at the Zeebrugge Hub in Belgium. This could suggest that the remedies were effective in limiting the potential anti-competitive effects of the merger.

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1 Introduction to the Study

Energy is essential to modern life. Reliable access to supply at competitive prices is crucial to people's well-being and for the growth and competitiveness of EU industry.

Energy markets, however, typically exhibit certain structural characteristics that could allow incumbent firms to exercise market power, which restricts competition and potentially generates higher prices and reduced consumer care.

The structure of EU energy markets has fundamentally transformed during the past two decades as a result of three successive waves of liberalisation directives – from national markets with vertically integrated monopolies to more competitive markets with separation between regulated (transmission and distribution) and competitive segments (production and retail). But there are still concerns over the functioning of these markets as evidenced by continued high market shares of incumbents, limited market penetration of new entrants, lack of cross-border trade, rising retail energy prices in several Member States and a lack of consumer confidence in these markets. Along with regulation, the European Commission has therefore also used instruments of competition policy to improve the functioning of European gas and electricity markets.

1.1 Objectives and scope of the study

This study describes and evaluates the impact of the European Commission's competition policy enforcement activities (see section 1.2) on the functioning of EU gas and electricity markets. Specifically, it addresses a set of five evaluation questions (listed in Table 1.1), using one or more of the following methods:

- Literature review covering policy and academic papers on competition issues in energy markets and the impact of competition policy enforcement and regulation on the functioning of these markets;
- Descriptive analysis of select indicators of market functioning and performance;
- Empirical analysis of the impact of competition policy enforcement activities on market performance across the EU, while controlling for changes in the regulatory and competition policy framework; and
- Case studies analysing the impact of specific decisions on relevant product and geographic markets using econometric approaches.

The table below shows how the above methods were used to answer the specific evaluation questions set out in the terms of reference (ToR).

Table 1.1 Methodological approaches to answering the study questions

Evaluation questions	Methods	Indicators	Data sources
Q1. Can one observe a **change in the functioning of energy markets** in the EU over the past two decades?	Descriptive analysis Literature review	▪ Concentration indicators (HHI, CR3, number of players) ▪ Number of new entrants/ change in number of players ▪ Level of vertical integration ▪ Market liquidity ▪ Price and market regulation ▪ Public ownership ▪ Wholesale and retail prices ▪ Price mark-ups	▪ Amadeus ▪ CEER ▪ Datamonitor ▪ DG ECFIN ▪ DG Energy ▪ ENTSO-E ▪ Eurostat ▪ IEA ▪ OECD ▪ Platts

Evaluation questions	Methods	Indicators	Data sources
		▪ Switching rates ▪ Productivity dispersion ▪ Boone indicator	
Q2. Can one observe a **change in competition policy enforcement** affecting energy markets in the EU over the past two decades?	Descriptive analysis Literature review	▪ EU merger and anti-trust cases in electricity and gas markets	▪ DG Competition
Q3. Has the enforcement of competition policy in the energy sectors contributed to **better functioning energy markets**? To what extent?	Literature review Broad econometric analysis Case studies	<u>Broad econometric analysis</u> ▪ Productivity dispersion ▪ Profit elasticity with respect to costs ▪ Investment ▪ Firm level productivity ▪ EU competition policy enforcement indicators ▪ National competition policy enforcement indicators ▪ Indicators of Product Market Regulation ▪ Other control variables (GDP per capita, population growth, energy imports, energy mix) <u>E.ON case study</u> ▪ Wholesale prices – German electricity markets ▪ Retail prices – German electricity markets ▪ Cross border electricity flows ▪ Oil prices ▪ Coal prices ▪ Gas prices ▪ Carbon prices ▪ Production of renewable energy <u>GDF/ Suez case study</u> ▪ Hub prices – ZEE hub and TTF ▪ Oil prices ▪ Coal prices ▪ Gas prices	▪ Amadeus ▪ APEX/ENDEX ▪ Argus McCloskey ▪ CEER ▪ CREG ▪ DG Competition ▪ DG Energy ▪ EEX/ EPEX ▪ ENTSO-E ▪ Fluxys ▪ National Power Exchanges ▪ OECD ▪ Platts ▪ Survey of NCAs ▪ US Energy Information Administration ▪ UX Company ▪ Verivox ▪ World Bank
Q4. Is there **complementarity (in terms of objectives and effects) between competition and regulatory policies** affecting the functioning of the energy markets? To what extent have we observed an increase in complementarity over the past two decades? Please explain	Literature review Econometric analysis Case studies	Same as above	Same as above

Evaluation questions	Methods	Indicators	Data sources
Q5. Do competition case investigations and case decisions affect the **design of sector regulations and the enforcement** of such regulations?	Literature review Case studies	Same as above	Same as above

*NB: The ToR contained two **optional** evaluation questions: (i) How did the sector inquiry affect: (a) competition policy enforcement (in terms of competition case investigations and case decisions); and (b) regulatory reforms aimed at market opening and market access (including regulations on unbundling, infrastructure access, interconnections between national markets, and tariff setting)? (ii) What has been the added value of competition policy enforcement in the energy sector at the EU level as opposed to the national level (in terms of interconnections between national markets and in cross border trade)? These questions could not be addressed by the present study due to time and budget constraints.*

1.2 Competition policy enforcement by the European Commission in gas and electricity markets

Over time, and particularly since 2002, the Commission has exercised the full raft of competition enforcement tools at its disposal, including merger control, antitrust legislation and state aid control, to prohibit anti-competitive conduct and mergers and eliminate state aids that distort the market.

In 2005, the Commission also launched a Sector Inquiry into the functioning of energy markets in response to sharp increases in gas and electricity wholesale prices and persistent complaints about barriers to entry and limited consumer choice.

This section provides an overview of these activities as context for the study.

1.2.1 The Energy Sector Inquiry (2005 – 2007)

The Final Report of the Sector Inquiry was published in 2007[1]. It reiterated and confirmed the five areas of concern highlighted in the Commission's 2005 Issues Paper, namely:

(i) *High levels of market concentration*, creating the scope for incumbents to exercise market power;

(ii) *Vertical foreclosure* resulting from insufficient or ineffective unbundling between supply and transportation activities;

(iii) *Lack of cross-border integration and cross-border competition* due to insufficient or unavailable interconnection capacity;

(iv) *Lack of transparency*, to the benefit of incumbents; and

(v) *Opaque and complex price formation mechanisms* such as oil indexed gas contracts, lack of trust in electricity spot prices, and the *setting of regulated end user tariffs below market prices*, thus discouraging new entry

In addition to the above competition concerns, the Final Report also identified the following issues:

- *Long-Term downstream contracts:* the Commission's investigations showed that in some Member States, the duration of retail contracts for industrial customers or

[1] The final report of the sector inquiry, as well as other related documents, are available on : http://ec.europa.eu/competition/sectors/energy/2005_inquiry/index_en.html

local distribution companies was so long that it amounted to tying and created barriers to entry. The Commission however, acknowledged that long-term contracts may be legitimated in upstream gas markets considering the scale of investments required.

- *Balancing:* balancing rules, imposed by network operators in both gas and electricity markets, were found to increase the complexity and costs of entry into a market. Existing balancing regimes were often found to favour incumbents and create obstacles for new market entrants.

The launch of the Sector Inquiry triggered several individual investigations (see section 1.1.2) and led to the adoption of the Third Energy Package in 2009. The Package consists of three regulations establishing an Agency for the Cooperation of Energy Regulators, on conditions for access to power network, and on conditions for access to gas network and two directives on common rules in the internal power market and in the internal gas market.

To address concerns highlighted in the 2007 Sector Inquiry, the three key aspects of the package, - were[2]:

- *Effective unbundling*: requiring that network operators be legally and functionally separate from the supply and generation or production activities.
- *Cross border integration*: stronger independence of national regulators also conferred with greater regulatory powers to monitor compliance of transmission and distribution system operators with third-party access rules, unbundling obligations, balancing mechanisms, congestion and interconnection management. This included powers to investigate the functioning of the gas and electricity markets, and to impose necessary and proportionate measures to promote effective competition and ensure proper functioning of the market.
- *Regulatory oversight*: to ensure fair competition between EU companies and third country companies, the package also included provisions to prevent control of transmission systems by companies from non-EU companies, unless they fulfil certain conditions. And the creation of the Agency for the Cooperation of Energy Regulators (ACER).

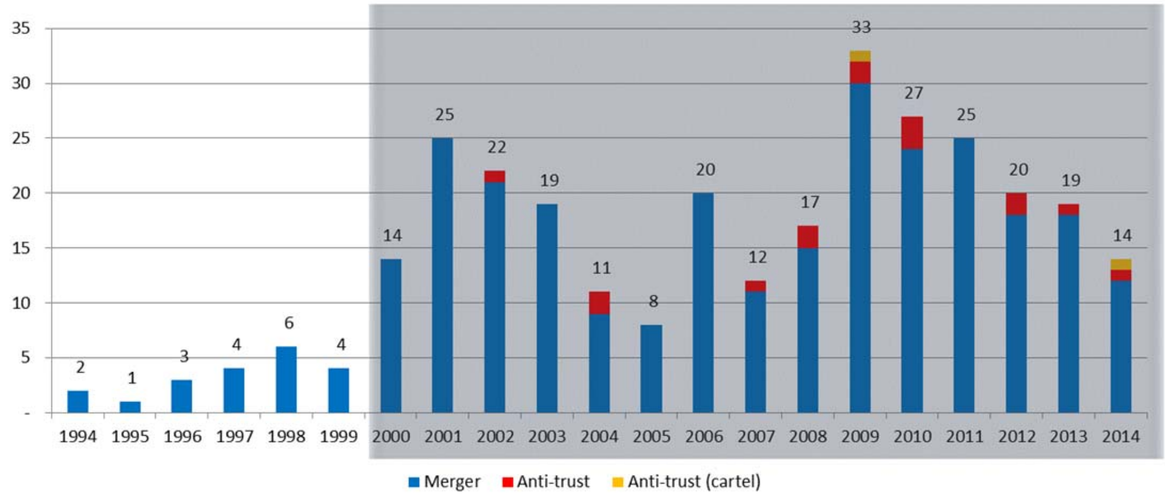
1.2.2 Anti-trust enforcement and merger control

During the past two decades (1994 to 2014), the Commission has handled 351 merger and anti-trust cases in gas and electricity markets across Europe. There has been a noticeable increase in EU competition policy enforcement activity since 2000 (when the first liberalisation directives were transposed in Member State legislation). Figure 1.1 shows the annual distribution of antitrust and merger cases handled by the Commission during this period.

The majority involved merger decisions in the electricity sector (Figure 1.2). Antitrust enforcement in gas and electricity markets by the EU has been relatively limited. Overall, the Commission handled 38 antitrust enforcement cases between 1994 and 2014, including three cartel investigations.

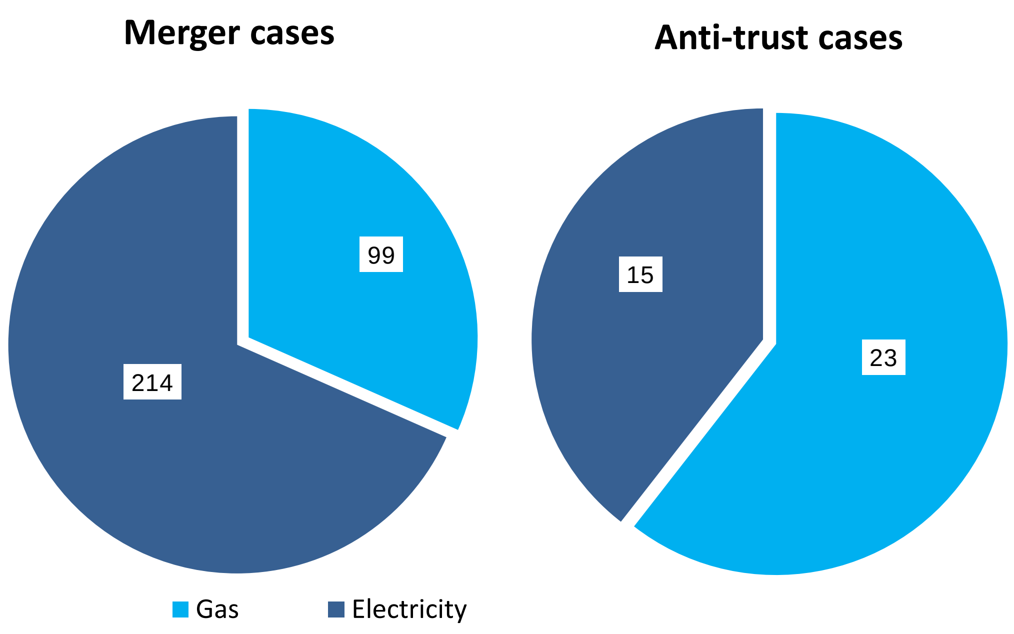
2 This section was written using the information on this page: http://www.linklaters.com/Publications/Thirdenergypackage/Pages/Index.aspx

Figure 1.1 Distribution of EU merger and anti-trust cases in electricity and gas markets



Source: DG COMP. Based on data extracted on 26/09/2014. NACE codes D35.1 and D35.2. NOTE: Sector inquiry excluded from anti-trust cases reported in 2007. By case end date.

Figure 1.2 Distribution of EU merger and anti-trust cases by sector

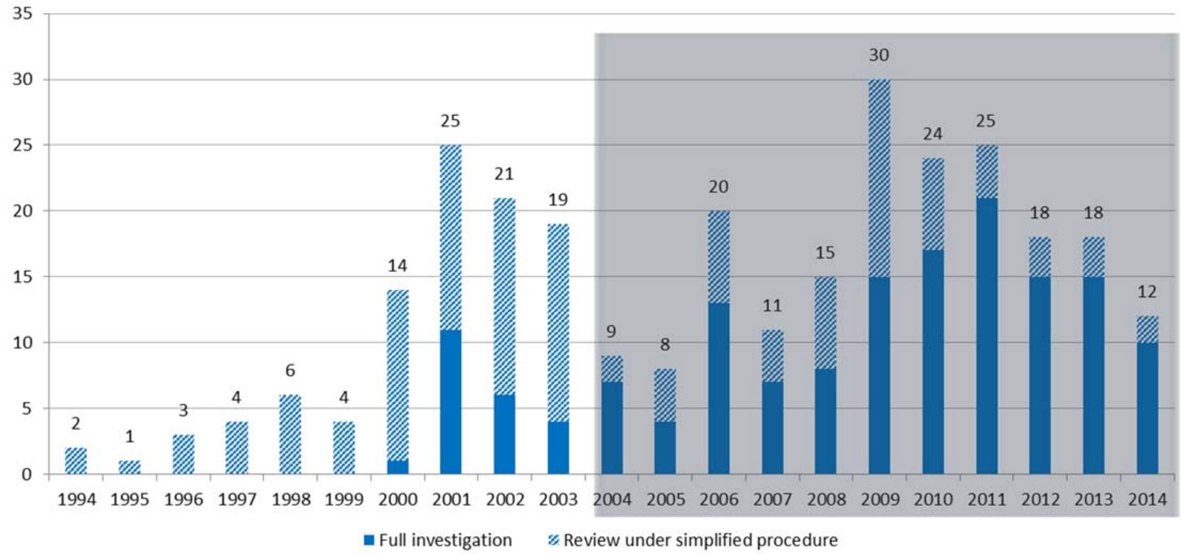


Source: DG COMP. Based on data extracted on 26/09/2014. NACE codes D35.1 and D35.2. NOTE: Sector inquiry excluded from anti-trust cases reported in 2007. By case end date

Until 2003, merger cases in gas and electricity markets were commonly handled via simplified procedures. If the merging firms are not operating in the same or related markets, or if they have only small market share below specified market share thresholds, the merger will typically not generate significant competition problems: the merger review therefore follows a simplified procedure involving a routine check.

Since 2003, a significantly higher share of the merger cases in gas and electricity markets have been subject to a full investigation, suggesting an increase in merger activity in these markets giving rise to competition concerns (Figure 1.3).

Figure 1.3 Distribution of EU merger cases by procedure



Source: DG COMP. Based on data extracted on 26/09/2014. NACE codes D35.1 and D35.2. By case end date.

EU merger control has played a key role in *limiting further horizontal and vertical integration in energy markets* which are already highly concentrated. For example, the 2008 GDF/Suez merger (examined later as a case study), which aimed to create one of the world's largest energy companies, as originally planned, would have weakened competition in the gas and electricity wholesale and retail markets in Belgium and in the gas markets in France by removing competition between GDF and Suez in these markets.

Our case study demonstrates that the remedies offered by GDF and Suez limited the potential anticompetitive effects of the merger (in Belgian wholesale gas markets which were the focus of case study) and that better access to the hub was achieved through ownership unbundling.

In the Electricité de France S.A. (EdF)/British Energy merger decision (2008), the package of remedies secured by the Commission aimed to *prevent unilateral horizontal effects*. This merger combined British Energy, the UK's largest power generator, and EdF, another significant UK electricity player with substantial coal- and gas-fired generation capacity. Although the merged entity would not have had high market share and still faced several competitors, the Commission's investigation identified real concerns. Specifically, the Commission was concerned that the transaction created the possibility for the merged entity to net-off its generation and supply requirements, thereby precluding the need for British Energy to sell most of its generation into the wholesale market, and for EdF to buy power in the wholesale market.

The Commission believed this could lead to a reduction of liquidity in the British wholesale electricity market, potentially causing demand foreclosure for generators, more difficulties for generators and suppliers to hedge their positions, increased market volatility and less reliable price signals (with attendant impact on generators' ability to secure financing for new projects). The merger was ultimately cleared by the Commission based on a package of structural and behavioural remedies provided by EdF.

In some cases, the *remedies put in place to mitigate the potential anti-competitive effects of a merger have also contributed to promoting market liberalisation.* For example, in 2001, the Commission authorised, subject to conditions, the acquisition of joint control of German electricity company Energie Baden-Württemberg AG (EnBW) by EdF and Zweckverband Oberschwäbische Elektrizitätswerke (OEW), an association of nine south-west German districts. The investigation concluded that EdF enjoyed a dominant position on the French market for the supply of eligible customers, with a market share of approximately 90 per cent. EnBW was considered one of the most likely potential competitors in the French market and was strategically well placed to enter the market for the supply of eligible customers. By acquiring EnBW, EdF would have strengthened its dominant position in France and also increased its potential for retaliation in Germany and would thus become less exposed to competition in France. There were two relatively standard elements to the remedies package and an innovative third element. This third element of the EdF remedy sought to address the competition concerns that had arisen in relation to so-called "eligible" customers in France, i.e., those whose electricity supply is open to competition. To resolve these concerns, EdF undertook to provide competitors with access to generation capacity located in France in the form of virtual power plants (5000 MW) and back to back agreements to existing co-generation power purchase agreements with a maximum of 1000 MW. According to the terms of the commitments, the contracts for access to the virtual power plants were to be awarded through an open, non-discriminatory public auction open to utilities and traders alike. These arrangements for access to generation capacity were to remain in place for a period of five years so as to allow sufficient alternative supply sources to become available

The Commission has not hesitated in *prohibiting anti-competitive mergers*. In 2004, the Commission decided to prohibit the proposed acquisition of joint control over Gás de Portugal (GDP), the incumbent gas company in Portugal, by Energias de Portugal (EDP), the incumbent electricity company in Portugal, and ENI, an Italian energy company. The Commission analysed the possible impact of the proposed operation on the gas and electricity supply markets in Portugal and concluded that the transaction would strengthen EDP's dominant position in the electricity wholesale and retail markets in Portugal. In particular, it would remove GDP's potential to compete in the electricity markets. Furthermore, since gas is now one of the most efficient ways to produce electricity, the concentration would have made current and possible future power producers in Portugal dependent on their main competitor, namely EDP. The concentration would also strengthen GDP's dominant position in the relevant gas markets in Portugal, through the foreclosure of a significant part of the gas demand (controlled by EDP) and the elimination of EDP as most likely entrant in the gas markets. Since most competition in energy markets comes from electricity incumbents entering the gas market and vice versa, this case demonstrates the Commission's strict approach to *mergers involving gas and electricity companies ("'convergence'' mergers).*

The Commission's intervention has also *prevented mergers with potentially anti-competitive effects* from going forward. In 2008, the proposed acquisition of the Hungarian oil and gas company, MOL by the Austrian oil and gas group, OMV was abandoned following the Commission's concerns relating to the combined market share of the companies in several energy markets. The proposed acquisition would have brought together two strong integrated oil and gas companies and given the merged entity a strong hold in both the petrol retail market and in the refining sector in several Central and Eastern European (CEE) countries. OMV offered a number of remedies (for example, offering to open the refineries to competitors) to address the competition concerns raised by the Commission, but these were deemed insufficient. OMV was not prepared to accept the remedies sought by the Commission and eventually withdrew the merger notification.

Finally, the Commission has also *acted when the conditions imposed by national authorities create unjustified restrictions to mergers of Community dimension*. In particular, the Commission has adopted three decisions under Article 21 of the Merger Regulation (two in the framework of the E.ON/Endesa case and one in the Enel/Acciona/Endesa case) to declare that some measures adopted by the Spanish authorities were incompatible with Community law, constituted unjustified restrictions to those mergers and should, therefore, be withdrawn. Given the Spanish authorities' failure to comply with the Commission request to withdraw the illegal measures, the Commission started infringement proceedings under Article 226 EC in the two cases. The European Court of Justice has recently clarified that in relation to the first one of these infringement cases (EON/Endesa) Spain violated EC law by failing to comply with the Commission decisions adopted on 26 September and 20 December 2006.

The Commission has taken **anti-trust enforcement action** to tackle *exclusionary conduct by dominant incumbents; exploitative abuses by dominant incumbents*; and *collusive behaviour*. For example, in 2007, the Commission opened an investigation into ENI's suspected abuse of a dominant position in the market for the transport of gas. There were concerns that ENI may have foreclosed competition in the Italian gas supply market by not granting competitors' access to capacity available on the transport network (capacity hoarding) or doing so in an am impractical manner (capacity degradation) and by strategically limiting investment in ENI's international transmission pipeline system(strategic underinvestment). In response to these concerns, ENI committed to divest its shares in the three companies operating the relevant international transport pipelines[3], thus ensuring that third-party requests to access the gas pipeline would be dealt with by an entity independent of ENI, thereby removing the potential conflict of interest resulting from the vertical integration of ENI.

In 2007, the Commission initiated anti-trust action against Distrigas in response to potential market foreclosure concerns relating to long-term gas supply contracts between Distrigas, the Belgian incumbent national supplier, and its large gas customers in Belgium. Given the very strong market position of Distrigas on the relevant market, the Commission was concerned that other suppliers find it difficult to do business with Belgian customers, due to the combination of two factors: the duration of the contracts and the volumes of gas tied to Distrigas. To address the Commission's concerns, Distrigaz made a series of commitments. In order to address the Commission concerns, Distrigas proposed commitments for a period of four years. According to these commitments, Distrigas was to ensure that at least 35 per cent of its volumes sold to large industrial users and electricity producers (representing about 20 per cent of total sales in the relevant market) would be contestable every year. In addition, the duration of all new contracts would be limited, with a maximum of five years applying to contracts with industrial users and electricity producers, and a maximum of five years applying to gas resellers

In the electricity sector, the Commission investigated E.ON's suspected abuse of its dominant position on the German wholesale market (2008). There were concerns that E.ON may have withdrawn available generation capacity from the German wholesale electricity markets (to raise prices), and may have deterred new investors from entering the generation market. The case resulted in substantial commitment by E.ON to divest 5000 MW of generation plants along with its extra-high voltage distribution network that structurally changed the German electricity market to the benefit of consumers (see case study later on).

Anti-trust enforcement in the electricity sector has also included interventions to prevent restrictions on trade in electricity between EU countries (e.g. Swedish interconnectors case, 2010).

The European Commission has tackled collusive behaviour in both gas and electricity markets:

- In July 2009, the Commission issued a Decision fining both E.ON and GDF Suez for having colluded to share the German and French gas markets. Each firm was ordered to pay €553m in fines for malpractices over the period 1999 to 2005.
- In 2014, the Commission imposed fines totalling € 5.979m on EPEX Spot and Nord Pool Spot – the two leading European spot power exchanges – for agreeing not to compete with one another.

[3] Namely: TAG, TENP and Transitgas, which bring gas to Italy from Russia (TAG) and northern Europe (the TENP/Transitgas system)

The above cases illustrate the range of competition issues addressed by the Commission. They also demonstrate the significance and variety of remedies applied by the Commission to prevent or eliminate anti-competitive practices.

1.3 Structure of this Report

The rest of the document is organised as follows:

- Section 2 summarises existing theories and empirical evidence of the effect of competition policy interventions on the functioning and performance of energy markets;
- Section 3 provides a stylised overview of the current state of EU gas and electricity markets;
- Section 4 presents the results of an empirical analysis of the impact of EU and national competition policy enforcement on long term market outcomes such as productivity and investment;
- Section 5 examines the impact of the Commission's decision in the specific case of abuse of dominance by E.ON on the functioning of German wholesale and retail electricity markets;
- Section 6 evaluates the impact of the Commission's decision on the GDF-Suez merger case on the functioning of wholesale gas markets in Belgium.
- Section 7 addresses the seven evaluation questions and discusses the policy and methodological conclusions emerging from this study.

This Non-technical Summary is accompanied by a separate Technical Report which provides full details of the theoretical and empirical work undertaken in the context of this study.

2 Findings from the literature

Previously, only one study has empirically evaluated the (ex-post) impacts of competition policy enforcement in gas and electricity markets. A wider pool of academic literature examines how mergers, ownership unbundling, long-term contracts or merger remedies affect competition in energy markets, but only a handful provide an empirical analysis of competition issues in energy markets using econometric approaches. This section summarises the most significant and relevant findings from these studies.

2.1 Ex-post analysis of the impact of competition policy enforcement in gas and electricity markets

Pozzi (2004) investigates the causes (or triggers) and ex-post effects of antitrust enforcement in US energy industries using a dataset of all federal cases (26 cases in total) representing the litigation activity of the US Department of Justice and the Federal Trade Commission in the oil, gas, coal and power sector from 1990 to 2004. He found some evidence of causality between antitrust enforcement and firm performance (industry markups and profits) in the electricity sector. Antitrust enforcement had no impact on overall industry profits in the oil and gas sector, although it reduced downstream markups. Pozzi explains that downstream markups have little bearing on firms' operating profits in the oil and gas sector, arguing that they mainly profit from crude oil prices and upstream operations.

2.2 Competition effects of mergers in the energy sector

In a relatively recent paper, Federico (2011) provides an in-depth qualitative analysis of the competition concerns raised by ten significant mergers in the energy sector in Europe[4] as well as the remedies proposed by the authorities to mitigate the potential adverse effects of these mergers on competition.

The author finds that six of the eight European transactions studied, raised horizontal concerns (which result from the loss of direct competition between players in a particular industry) in relevant wholesale energy markets (gas and/or electricity).

At a wholesale level:

- Horizontal effects were identified even in cases where the combined market share of the merging parties was relatively low (e.g. the 2008 EDF/British Energy merger case described in 1.2.2); or where one of the parties was a fairly small competitor to incumbent suppliers (e.g. the 2006 GDF/Suez case analysed later); and even where loss of competition is potential as opposed to actual (e.g. the RWE/ Essent merger case, 2009).
- Horizontal effects were particularly prominent in the electricity generation sector, given the volatile demand of the market and the presence of several generation technologies with different marginal costs. According to the author, these characteristics lend themselves to the risk of price spikes, which may benefit the merged entity.

[4] These consist of the eight largest transactions assessed by the European Commission in the energy sector between 2004 and 2009 and two major gas-electricity mergers in Spain over the same period. The first was a proposed merger between the gas and electricity incumbents (Gas Natural and Endesa in 2005-2006) that eventually did not materialise for commercial reasons. The second was a smaller, but still significant merger between Gas Natural and Union Fenosa which was cleared by Spanish competition authorities in 2009.

At a retail level, horizontal effects were identified in five out of the eight European transactions analysed. These concerns predominantly related to actual or expected loss of competition for both residential and industrial consumers, due to greater convergence between gas and electricity retail offers.

The author notes that the Commission also identified several "non-horizontal" or vertical theories of harm in its assessment of mergers, which he warns are inherently harder to evaluate and substantiate than horizontal effects. The main vertical effects raised by the eight European mergers studied by Federico can be summarized as follows:

- *Input foreclosure due to lack of full ownership unbundling of some network assets (e.g. electricity transmission, gas storage and transportation)*. If a merger brings together network assets that have not been unbundled with activities in the liberalized parts of the market (e.g. electricity generation; and gas and electricity retail), adverse non-horizontal effects may arise. In the presence of effective price regulation of the network inputs, these could take the form of quality-degradation of the network input to rivals of the merging parties. The integrated firm may face incentives to engage in such strategy precisely because it is price regulated; meaning that the standard argument that there is only 'one monopoly profit' to be obtained would not hold.
- *Input foreclosure of non-network inputs.* A vertical merger could potentially serve as an incentive for the merging party to increase the price of the input paid by competitors.
- *Customer foreclosure.* Vertical mergers may deprive upstream entrants from contestable downstream demand, raising entry barriers and discouraging new competitors.
- *Loss of market liquidity.* In energy mergers, there may be a danger that that consolidation could result in the internationalization of wholesale electricity trading between merging parties may significantly reduce market liquidity and thereby harm customers. Federico warns internalization would not in itself raise wholesale electricity prices since an equal amount of power would be removed from the sales and purchases in the market (by definition). However, the theory of consumer harm is more indirect and relates to the greater price volatility that a reduction in liquidity may lead to, and possible barriers to entry (either upstream and/or downstream) that would arise as a result.

2.3 Impact of convergence mergers on competition in energy markets

Because gas is an important input for electricity generation, wholesale natural gas and electricity markets are also vertically inter-related. Mergers between gas and electricity firms are sometimes called 'convergence' mergers and are increasing fast, driven by more use of gas as a fuel for electricity generation and downstream opportunities for utilities to offer bundled gas and electricity supply to their consumers (Hunger, 2003; Verde (2008)).

Several papers have extensively analysed whether vertically related firms could benefit from foreclosing non-integrated rivals (see Rey and Tirole 2004 for a recent survey). Studies of vertical relationships in energy markets (e.g. Granitz and Klein 1996, Bushnell et al. 2005) often explain their findings using this foreclosure argument. Rupérez-Micola et al. (2008) claim that higher prices are related to the existence of financial netback effects, or spark spread pricing, in energy markets, which prices wholesale natural gas against wholesale electricity prices, which, in turn, are usually set with reference to retail tariffs.

Federico (2011) also documents concerns in several merger cases regarding the integration of gas and electricity companies. Both input and customer foreclosure can be an issue. The vertically integrated merging party may face incentives to seek to increase the price of the input (e.g. wholesale gas) to rival downstream supplier (e.g. electricity generation company), in order to benefit its own downstream subsidiary. A vertical merger may also deprive upstream entrants from a source of contestable downstream demand, thus raising entry barriers and potentially discouraging entry in the first place.

Arguing against clearance of the Gas Natural/Endesa proposed merger, Barquin et al. (2006) claimed that a merger between electricity and gas incumbent companies would also instantly become dual fuel operators before any other existing or potential competitor have a chance to do so. Further to this, once a country is dominated by a national giant that integrates gas and electricity, it will be rare to find these champions engaging in cross-border competition. Instead, Padilla et al. (2005) claim that it is not necessary that, absent the merger, a foreign electricity company could buy gas from Gas Natural to generate electricity and then for Gas Natural would use that generation to offer dual fuel services. A foreign company could sell gas to Endesa to be used in its gas-fired plants and then cooperate with Endesa in the resell market to sell dual fuel offer services.

2.4 Impact of vertical linkages on competition in energy markets

2.4.1 Impact of vertical integration

Newbery (2007) argues that vertical mergers may be efficient. Wholesale markets create risks that are complementary for generators and suppliers and this complementarity could result in efficiency gains. When wholesale prices are high, generators profit, but suppliers who have contracted to sell at fixed prices face rising costs and falling profits, and vice versa. These negatively correlated risks create both a demand for and supply of hedging. But if contract markets are thin or illiquid, mergers (and as discussed below, long-term contracts) between generation and supply are an attractive risk-reducing and hence synergistic strategy. Moreover, vertical integration can also potentially reduce the cost of capital for firms, by reducing exposure to volatile market risk[5].

On the flip side, vertical integration can reduce liquidity in wholesale markets which can act as a barrier to entry or expansion for non-integrated suppliers already in the market. Vertically integrated firms may use their position in the wholesale markets to undermine competition from independent generators by reducing willingness to sign long-term offtake contracts with independent generators; reducing willingness to trade certain products or to trade with independent generators; or dispatching their own generation even when cheaper generation was available from other firms (customer foreclosure). Vertically integrated firms may also take action in the wholesale electricity market to disadvantage independent retailers through input foreclosure: if a firm has any market power in generation, it could increase wholesale electricity prices by generating less at any given price, which would increase input costs for independent suppliers. A vertically integrated firm could also try to restrict trading or otherwise worsen liquidity, which might either raise traded prices or impose a risk premium on independent suppliers (Ofgem, 2015).

Fiorio and Florio (2009) show that vertical integration in the electricity sector leads to higher final consumer prices. Using a standard probit model, they conclude that consumers are less satisfied if firms are integrated. In line with earlier studies, their results for the gas industry differ substantially. Herein, prices and vertical integration are uncorrelated and consumers are more satisfied with higher levels of integration. Similar studies dealing exclusively with the gas industry are Brau et al. (2010) and Growitsch and Stronzik (2009).

2.4.2 Impact of vertical relationships in the form of long term contracts

Long-term contracts have become one of the main priorities for antitrust enforcement (and one of the most active areas of academic research). In the energy sector enquiry, the

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5 Integrated suppliers are likely to have stronger credit ratings, allowing them to post lower levels of collateral. Without the benefit of this, non-integrated suppliers are required to post significant collateral to trade in wholesale markets (Ofgem, 2014)

Commission stresses that integration between generation and retailing, including in the form of long-term supply contracts, creates a risk of foreclosure. Indeed both vertical integration and vertical linkages between generation and supply (in the form of long term contracts) have more or less the same impact on the market. The only difference between a long-term contract over 20 to 40 years (corresponding to the lifetime of a generator) and vertical integration is that the former lacks "direct investment and operational management and control" (Chao et al., 2005). In both cases, wholesale markets are by-passed and market entry of new competitors may be hampered.

The general argument put forward – which is valid for both gas and electricity – is that vertical relationships reduce the liquidity of wholesale markets. Consequently, prices are more volatile and the signal quality sent to market actors is lower. This increases the risks for potential entrants into generation; they must either withdraw or invest both downstream and upstream. In the latter case, a vicious circle is created and the development of wholesale markets remains marginal. In the case of gas, entry barriers are even higher because of contracts that bind national historical importers and oil and gas majors for long periods. New entrants face both low liquidity in downstream wholesale markets and a shortage of gas available for import. The enquiry argues that it is hardly possible for a long-term supply contract not to lead to the elimination of competition on a substantial part of the products.

However, as argued by Hauteclocque and Glachant (2008), long-term contracts allow firms to hedge price and quantity risks and therefore, facilitate investment particularly in a context of under-developed and/or volatile markets. In under-developed spot markets, future cash flows are uncertain which puts off risk-adverse investors from investing in generation capacities, thus leading to under-investment (Neuhoff and de Vries, 2004). Long-term contracts – by providing cash flow certainty and stability – can help generation companies secure project financing. By reducing risks, long term contracts facilitate market entry and investments, thus contributing to long term generation adequacy. Moreover, it is argued that long term contracts contribute to fuel mix diversity by facilitating investment in baseload technologies such as nuclear.

2.4.3 Impact of ownership unbundling

In contrast to the European Commission's view, the academic literature is ambiguous as regards the positive effects of ownership unbundling. The arguments against ownership unbundling arise from the existence of vertical scope economies. Specific features of electricity markets - such as the need to balance demand and supply in real time; scale of investment required in generation and network assets and the irreversible nature of the investment - favour vertical integration between different supply stages resulting in vertical scope economies. The benefits of vertical integration can be significant in terms of coordination economies, market risk economies (including hold-up risks) and specialisation economies (Kwoka, 2002; Meyer, 2011). In his review of theoretical and empirical literature on sources and magnitudes of vertical synergies in the electricity sector, Meyer finds that:

- Generation unbundling - separation of the generation stage from the two network stages (transmission and distribution) and the retail function – can result in synergy losses of 17 percent of total costs for the average company.
- For distribution and retail unbundling – separation of distribution and retail from the combined generation and transmission - synergy losses are estimated at below 5 percent.
- Pure network unbundling options - transmission unbundling and distribution unbundling only separate the respective network part from all other supply stages – result in synergy losses between 2 and 5 percent.

Several studies cover the impact of different types of regulation or liberalisation. Steiner (2001) is one of the first authors to deal with the effects of liberalisation on consumer prices.

In her analysis, she takes data from 19 OECD countries between 1986 and 1996. She finds that unbundling increases efficiency for the overall sector, but the benefits are not necessarily passed on to private consumers via lower prices. Unlike Steiner (2001), Hattori and Tsutsui (2004) find that unbundling increases prices.

Copenhagen Economics (2005) examines the level of market opening in several network industries via a dynamic panel data model. It focuses on the EU-15 countries from 1993 to 2003 and concludes that higher levels of unbundling (with ownership unbundling as the highest form) generates price reductions and increased efficiency. They also conclude that unbundling the transmission grid is the most important element of market opening. But they cannot confirm this negative effect of unbundling on prices for the gas sector.

Alesina et al. (2005) analyse different regulatory reform processes in seven network industries in 21 OECD countries between 1975 and 1998. They show that regulatory reform of product markets has a positive effect on investments. Analysing the gas and electricity sector jointly, they conclude that investments increase with higher levels of unbundling.

Nardi (2010) disputes these findings. He analyses the impact of ownership unbundling on grid investments and quality. Although he finds higher grid investments in the network, he further shows that a substantial lack of quality emerges that confirms the resulting diseconomies of coordination when separating ownership and control of different company parts. He asserts his results should be seen as first findings since only qualitative investment data is available and therefore there is no multivariate regression analysis.

Gugler et al. (2013) provide an empirical analysis of the effects of ownership unbundling of the transmission grid and final consumer prices on investments and corroborate the inherent trade-offs present in large sunk-cost network industries. They estimate a dynamic panel regression model for the electricity industry in 16 European countries between 1998 and 2008, and find that ownership unbundling significantly reduces aggregate investment in the electricity industry. They also estimate an investment reducing effect of third-party access to the electricity transmission grid. Moreover, there is a general trade-off between static and dynamic efficiency. Higher electricity end-user prices induce larger aggregate investments in the sector.

2.5 Remedies applied by authorities to mitigate competition concerns

Some of the most recent and important energy merger cases have been approved after parties proposed commitments to the Commission (for example between GDF and Suez which is analysed later in this report in section 7). Some of the antitrust cases, as for example the E.ON case analysed later on in this report (see Section 6), have also involved commitments or remedies, both structural and behavioural.

In the energy market, structural remedies require the merging parties to divest part of their capacity and to open the market to new entrants and competitors interested in buying out the divested plants. Federico (2011) found that the European commission relied almost exclusively on structural divestments to address the competition concerns raised by the eight European mergers he examined. In his view, fairly demanding remedies were imposed by the Commission even in circumstances where the combined market shared of merging entities was relatively low. He concludes that particularly effective remedies are those that involve the sale of price-setting generation plants, network assets and merging entity’s controlling stakes in existing competitors.

As argued by Verde (2008), structural remedies are irreversible and their success and effectiveness largely depend on the party to which the capacity is permanently divested. If the party is able to compete effectively, the additional capacity could reinforce its position and bring pro-competitive effects. Otherwise, negative effects prevail and the benefits in terms of lower concentration of the market are outweighed by the losses in terms of lower scale/scope economies.

Aside from structural remedies, competition authorities have also made use of behavioural remedies in energy markets. The latter broadly fall into two categories: virtual power plant (VPP) divestitures and gas release programmes (GRPs). The first one applies to the electricity market and the second to the gas market. In both cases, the company is not required to divest indefinitely its capacity, but only to release temporarily part of its production/capacity to its competitors, generally through devices such as auctions or bilateral agreements.

There is a vast body of academic grey literature examining the appropriateness of the remedies applied by the Commission in specific energy market cases. A particularly insightful and in-depth analysis has been carried out by Sadowska (2011), wherein the author critically notes that anti-trust cases are not being fully investigated to establish whether or not there has been a breach of competition rules; instead, the Commission only summarises its preliminary concerns regarding allegedly anti-competitive behaviour and specifies commitments agreed with the undertaking as a remedy to these concerns. On the basis of an in-depth legal analysis of two anti-trust cases[6], the author argues that competition policy was applied by the Commission beyond its proper limits in order to meet the objectives of sector-specific regulation in the electricity sector i.e. liberalisation and integration of energy markets. And while the commitment decisions might have contributed to achieving the policy objectives of the internal electricity market, but their use for that purpose might have negatively affected the electricity market either indirectly, by application of sector-specific regulation or competition policy building on previous commitment decisions, or directly, through the implementation of inappropriate commitments in individual cases.

2.6 Summary of key findings

The key findings from literature are summarised as follows:

Impact of competition policy enforcement on the functioning of energy markets. There is hardly any empirical literature on the effects of competition policy enforcement in energy markets. We could only identify Pozzi, (2004) as a major study that empirically investigates the causes and (ex-post) effects of competition policy (antitrust) enforcement in US energy industries. The broad econometric analysis and the case studies analysed in subsequent chapters are new to the literature.

As regards the main results of Pozzi's work, he found little evidence to suggest that anti-trust enforcement leads to a "material and measurable" reduction in the exercise of market power. Still, enforcement is found to have had some impact on firm profits: in electricity markets, profits decrease, whereas in the oil and gas industry there is no effect on firm profits, but downstream margins fall as a result of anti-trust enforcement.

Impact of mergers on competition. Energy sector mergers can give rise to horizontal effects (loss of direct competition between merging firms) and non-horizontal effects such as input foreclosure due to lack of full ownership unbundling of some network assets (e.g. electricity transmission, gas storage and transportation); input foreclosure of non-network inputs; customer foreclosure; and loss of market liquidity.

In theory, it may be argued that vertical mergers (between generation and supply companies) lead to efficiencies by providing a financial hedge against volatile wholesale energy prices and a natural hedge against balancing risk. Moreover, vertical integration could potentially reduce the cost of capital relative to similar non-integrated businesses, by

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6 The first case concerns the alleged abuse of its dominant position by E.ON by withholding generation capacity in order to raise prices in the German wholesale electricity markets. The second case concerns the alleged abuse of dominant position by the Swedish network operator, Svenska Kraftnät (SvK). The network operator allegedly limited cross-border transmission capacity

reducing exposure to volatile market risk. On the flip side, vertical integration has the potential to adversely affect competition by reducing liquidity in wholesale markets. Moreover, empirical evidence shows that vertical integration leads to higher final consumer prices in electricity markets and lower levels of customer satisfaction. In gas markets on the other hand, vertical integration was found to be uncorrelated with prices, but associated with higher levels of customer satisfaction.

Impact of convergence mergers. The literature warns of the potential anti-competitive effects of convergence mergers (i.e. mergers between gas and electricity companies) such as input and customer foreclosure.

Impact of vertical linkages. Both vertical integration and vertical relationships between generation and supply (in the form of long term contracts) can act as a barrier to market entry or expansion by reducing liquidity in the wholesale markets. On the other hand, vertical linkages allow firms to hedge price and quantity risks, thus facilitating investment and contributing to long-term generation adequacy and fuel mix diversity.

Impact of ownership unbundling. The literature is inconclusive about the effects of ownership unbundling on end-user prices or on investment incentives. At a very basic level, unbundling can result in loss of economies that arise from vertical integration or linkages. On the other hand, empirical evidence shows that unbundling generally results in improved efficiency. But, academic literature provides contradictory evidence on whether these efficiency gains are passed on to consumers in the form of lower prices or not. Similarly, empirical evidence on impact of unbundling on investment is contradictory.

Design of remedies. Authorities have used both structural and behavioural remedies to address competition concerns arising from mergers or potential anti-competitive behavior. Structural remedies require the merging parties to divest part of their capacity and to open the market to new entrants and competitors interested in buying out the divested plants. Behavioural remedies mainly consist of virtual power plant (VPP) divestitures in electricity markets and gas release programmes (GRPs). Some academics have expressed concern that the Commission may have used competition policy tools to promote regulatory objectives i.e. liberalisation and integration of energy markets across Europe.

3 Descriptive analysis of the functioning of European gas and electricity markets

We carried out a high-level descriptive analysis of select indicators of market characteristics and outcomes to detect observable changes in the functioning of European gas and electricity markets over the past decade or so and to get a broad picture of the current state of the markets (see Figure 3.1). Due to limited availability of time series data for several indicators, it was not possible to cover a 20 year period for this analysis. At best, available data allows us examine the changes that have occurred in the markets since the 2007 Sector Inquiry.

Figure 3.1 Indicators selected for the descriptive analysis of European gas and electricity markets

Market characteristics

Market concentration
- CR3 - The share of the three largest companies (gas / electricity)
- Number of players in a market
- Herfindahl-Hirschman Index (HHI)

Barriers to entry
- OECD vertical integration index
- Number of new entrants / change in players
- Market share of cross border entrants

Market liquidity
- Trading volumes at hubs

Regulation
- Overall levels of market regulation
- Price regulation of households and non-household consumers.

Public ownership
- Public ownership of first generation producer

Market outcomes

Prices
- Price trends / evolution:
  - Wholesale prices
  - Retail prices
- Price dispersion

Mark-up
- Mark up wholesale to retail prices

Switching
- Switching rates

Intensity of competition
- Productivity dispersion
- Boone indicator (elasticity of relative profits with respect to relative costs)

Source: own figure

3.1 The state of competition in European electricity markets

3.1.1 Market shares and concentration

High market concentration can be problematic because it creates the scope for dominant firms to exercise market power. The 2007 Sector Inquiry highlighted that generators can influence prices in two main ways: either by withdrawing capacity from the market, or by setting high prices when their production is required to meet demand. Since the Sector Inquiry, market concentration in electricity generation – as measured by the Herfindahl-Hirschman Index (HHI) - has fallen in almost all Member States except for Germany and Hungary (which have seen a tiny increase in the value of the index). However, **wholesale markets in several Member States remain highly concentrated and characterised by**

the continuing dominance of former monopoly generators. Market shares of above 20 per cent for the largest generator could be considered a cause for concern. In 16 Member States, the market share of the largest generator exceeds 20 per cent and in 18 Member States, the value of the HHI measure exceeds the commonly accepted threshold for highly concentrated markets (HHI= 2,000). Moreover, the small island nations of Cyprus and Malta are still characterised by a complete monopoly, with 100 per cent of their electricity generated by the largest (sole) generator. Member States such as Germany, Finland, Italy and the Netherlands exhibit relatively low levels of market concentration.

Retail electricity markets show similar patterns of concentration (with an average HHI of almost 4,500 and CR3[7] of 74 per cent across the EU). In 14 Member States, the market share of the three largest suppliers exceeds 60 per cent, indicating high levels of concentration in these markets. Incumbents have been able to maintain their market shares, and there have not been enough new entrants in these markets (European Parliament, 2010). On the positive side, market concentration, in general, has decreased during the last decade (on average the CR3 indicator has decreased by 5 per cent at an EU level between 2007 and 2013). A mixed picture emerges at national level. For example, in Bulgaria and Lithuania, the CR3 indicator almost halved between 2007 and 2003, whereas in Poland and Slovakia, the CR3 ratio has increased significantly in recent years.

3.1.2 Vertical integration

Available data shows that, **although the level of vertical integration has on average decreased since 2007, it remains reasonably high across Europe** (as measured by the OECD vertical integration indicator[8]). There are differences across Member States. For example, Bulgaria had the highest level of vertical integration in 2013 with an index value of 5.25, followed by France, Germany and the UK with an index value of 4.69. The lowest levels of vertical integration were observed in Portugal (2.45), Belgium (3.00) and Ireland (3.00).

3.1.3 Regulation

The OECD indicators of Product Market Regulation provide an indication of the overall level of regulation in electricity markets across Europe. The indicator is composed of four sub-indicators measuring the degree of public ownership, entry regulation, vertical integration and market structure. As expected, regulatory environment in electricity markets varies across Europe with Germany, Portugal, Spain and the UK having a less regulated market compared to Cyprus, Croatia, Latvia and Malta which are highly regulated. As part of the broader econometric analysis, we examine the interplay between competition policy enforcement and regulation by distinguishing between effects in high and low regulated markets.

Drilling down further into specific elements of regulation, we note that **price regulation in the household segment of the market exists in more than half of the Member States**. **For industrial consumers, regulated prices are present in 11 of the 28 Member States**. Price regulation - particularly when these prices are set below market prices and not in line with wholesale market prices – can distort the functioning of the market by (i) strengthening the position of the historical incumbent; (ii) making it difficult for suppliers to recuperate their costs, thus discouraging market entry; (iii) reducing the incentives for firms to invest and modernise in infrastructure and services; (iv) damaging the competitiveness of European

[7] Market share of the largest three suppliers. Ideally, the top three suppliers should have a combined market shares of less than 60 per cent

[8] The value of the OECD vertical integration indicator ranges from1-6 . It is based on a simple average of the degree of vertical integration over the four segments of the market: generation/import, transmission, distribution and supply. Rating scale is as follows: a 0 is ownership separation, 3: legal separation, 4-5: accounting separation, 6: no separation

businesses by burdening them with higher energy costs ; (v) leading to over-consumption (European Commission, 2014). Moreover, regulated prices may discourage switching by acting as focal point for alternative offers which will cluster around the regulated offers. This, in turn, may produce a negative effect on incentives to enter the market, competition among suppliers and quality of services (ACER, Market Monitoring Report 2014).

We also looked specifically at ownership unbundling in electricity markets. The Third legislative Energy Package proposed in 2009, which applies to both electricity and gas, requires an effective separation of the transmission networks´ operation from supply and generation activities (unbundling). In the transmission segment, there are several ways to unbundle: (i) separation of accounts and an independent operator (ITO – Independent Transmission Operator); (ii) operational separation where a company can operate the network without owning the network (ISO – Independent System Operator); and (iii) full divestiture of both entities (ownership unbundling). The latter is widely accepted as the optimal model because it eliminates any incentives to discriminate. **According to the latest information (2013), 15 Member States have chosen to apply the ownership unbundling model on at least one Transmission System Operator (TSO) in electricity**.

3.1.4 Public ownership

Competition problems associated with public ownership include control issues, preferential access to capital and distortions of competition both for and in the market which can be exacerbated by regulatory capture. We therefore looked at data on public ownership of the first generation producer compiled by the European Commission (DG ECFIN, 2014). Latest available data (2010) shows that **the electricity sector still displays high levels of public ownership of the first generation producer (> 50 per cent)**. The average across all Member States stands at 61.6 per cent with 95-100 per cent public ownership in 11 Member States. There is 100 per cent ownership in Bulgaria, Cyprus, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Slovenia and Sweden. Many of these are more recent accession countries (with the exception of Sweden), which may have been pursuing market liberalisation policies for less time. In contrast, Belgium, Germany, Portugal, Spain and the UK have completely divested the previously state-owned assets of the first generation producers.

3.1.5 Prices

Although there is evidence of wholesale price convergence across national markets in recent years (2008 to 2013), price differentials remain significant. In 2013, the lowest average wholesale baseload electricity prices were observed in Romania (38.59 €/ MWh), while the highest prices were observed in Italy (74.21 €/MWh), resulting in a price differential ratio of 1.9 between the cheapest and the most expensive country in the EU. Prices in Italy, Ireland and the United Kingdom were among the highest in the EU in 2013, either because of the lack of sufficient interconnection capacities to neighbouring power markets (Italy and Ireland) or because of the dominance of expensive generation fuels in setting the marginal price in the wholesale market (natural gas in the case of the UK) (European Commission, Quarterly Report on Electricity Markets, Q4-2014).

The average retail electricity price for households has increased from €0.14/KWh to €0.18/KWh between 2007 and 2014, with an average year-on-year change of 5 per cent[9]. For industrial customers, prices have increased to a slightly lesser extent from €0.09/KWh to €0.11/KWh over the same period and similarly had an average year-on-year change of five per cent[10]. Both of these are much higher than the average inflation rate of 2.12 per cent for the EU over the same period.

9 Consumption band DC for households (2,500 KWh < consumption < 5,000 KWh)

10 Consumption band IC for industrial customers (500 MWh < consumption < 2,000 MWh)

Huge price differentials remain across Member States as far as retail electricity prices for households are concerned, although retail electricity prices for industrial consumers appear to be gradually converging:

- For households, prices range from €0.09/KWh in Belgium to €0.30/KWh in Denmark and Germany, resulting in a price differential of 3.5. The lack of convergence could be due to the increasing importance of non-market elements (such as network costs, taxes and policy levies) within the final retail prices, or other structural issues such as competition or the presence of end-price regulation.
- For industrial consumers, prices range from €0.07/KWh in Finland and Sweden to €0.19/KWh in Malta, resulting in a price differential of 2.7. The smaller price differential could be due to the fact that industrial consumers are subject to less retail price regulation compared to the household sector and better negotiating position of industrial consumers, leading to better competition among power utilities.

The mark up on wholesale prices (i.e. the difference between wholesale prices and the energy component of the retail price) can be indicative of the level of competition in the electricity market (with persistently high mark-ups associated with low levels of competition). **The average electricity price mark-up across the EU has increased in recent years from €11.17/ MWh in 2008 to € 14.12/ MWh to 2013.** Electricity price mark-ups are the highest in Greece, the UK and Germany and negative in some Member States (the Czech Republic, Lithuania, Romania). Mark-up differences can be explained by cross-country differences in operating costs of suppliers, volatility in wholesale prices, market size and consumption levels . In Member States like Lithuania and Romania, mark-ups are negative because of the existence of regulated prices (as retail energy price component seems to have been set below wholesale energy prices). In the Czech Republic and Spain on the other hand, negative mark-ups could be due to significant entry/ exit activity (CEER/ACER, 2014 Market Monitoring Report).

3.1.6 Switching

The ability and willingness of consumers to switch in response to price signals is an important aspect of well-functioning markets. In competitive markets, we would expect to see consumer actions, such as the threat of switching supplier, exerting competitive pressure on suppliers. If switching is discouraged or impeded, it could deter new entrants from entering the market, on the assumption it will be difficult to persuade consumers to switch from their existing provider. This could potentially diminish the effectiveness of competition.

Data on switching rates in electricity markets is patchy and scarce, making it difficult to draw any conclusions. Available data shows that **electricity switching rates are low in several Member States (< 10 per cent) except for Portugal, the Netherlands, Spain and the UK** which have relatively high levels of switching (ranging from 13 to 26 per cent). A low switching rate in itself is not indicative of market mal-functioning, but other qualitative evidence suggests that there might be barriers to switching in energy markets (CEER/ACER, 2014 Market Monitoring Report). Low switching rates support the conclusion that the actual level of competitive pressures arising from consumers in electricity markets may be limited.

3.2 The state of competition in European gas markets

3.2.1 Market shares and concentration

Although high levels of market share of the largest gas operator >20 per cent) can be seen for 20 Member States (including the presence of a monopoly supplier in three Member States), it is difficult to interpret the market share of the largest producer in isolation because the market structure depends on many factors (e.g., the level of gas endowments within a country, the infrastructure to import, etc.). In the UK, the largest gas producer has a relatively low share of the market, because the UK has pursued strong liberalisation strategies, particularly in the upstream elements of the gas market (e.g, wholesale shipping for gas). These markets have been liberalised more completely than retail markets, and such policies are considered relatively successful[11].

Retail gas markets remain highly concentrated in most Member States, even more so than electricity markets. In 18 Member States, the market share of the three largest suppliers exceeds 60 per cent, indicating high levels of concentration in these markets and the HHI is above the 2,000 threshold in many countries for which data is available. The high level of concentration indicates that retail competition in many countries is still not well developed.

3.2.2 Vertical integration

Vertical integration features strongly in most EU national gas markets. In 18 Member States, the value of the OECD vertical integration was greater than 4 in 2013, suggesting high levels of vertical integration. Exceptionally in the UK, the gas market does not have a vertically integrated structure.

3.2.3 Regulation

The overall level of regulation of gas markets is notably high in Bulgaria, Finland, Greece, Latvia and Poland, as per data compiled by the OECD. Gas markets are fully liberalised in the UK and there is little regulation in Germany, Spain and Portugal.

The level of entry regulation, indicating the ease of entry into the market, is on average very low with an index value of 0.54 for the EU . In most Member States this indicator is below 1 with the exception of Finland (4) and Latvia (5). Post-2007 this indicator has slightly increased from an average of 0.41 in 2007.

Many Member States continue to regulate retail gas prices. Price regulation in the household segment was prevalent in 14 EU Member States in 2013, while 11 countries also regulated prices for industrial customers. Most commonly a rate-of-return or cost-plus regulation is applied. All price regulation regimes use some kind of market reference in setting prices. Regulation with direct link to wholesale price exists in Denmark.

Finally, we also looked at ownership unbundling in gas markets. According to the latest information (2013), **15 Member States have chosen to apply the ownership unbundling model**.

3.2.4 Public ownership

High levels of public ownership of first generation producer (>50 per cent) can be observed in eight Member States. Romania, Bulgaria, Denmark and Ireland all have a significantly higher than average proportion of public ownership (all above 75 per cent).

3.2.5 Prices

There are significant differences in retail gas prices across the EU: in 2014, the lowest estimated household price in consumption band D2 (5.56 MWh < consumption < 55.6 MWh) could be observed in Romania (3.10 Eurocent/kWh), while the highest price was recorded in Sweden (11.86 Eurocent/kWh), resulting in a price differential ratio of 3.8 between the cheapest and the most expensive Member State in the EU. While this ratio is rather high, it shows a declining trend since 2011 when it was 4.2.

Overall, retail gas prices for households have increased by 35 per cent (EU average) between 2007 and 2014 (from 5 Eurocents /KWh in 2007 to 7 Eurocents/KWh in 2014) with an average year-on-year change of 4 per cent (higher than EU average inflation of 2.12 per

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[11] London Economics. 2012. ‘Energy Retail Markets Comparability Study’. *A report for DECC.*

cent). Almost all Member States recorded inflation-busting increases in retail prices over this period, with the exception of Hungary and Romania where retail prices actually fell. In these countries, end-user prices are regulated and are set below wholesale prices (see below).

Compared to 2013 however, retail gas prices for households on average fell by 2 per cent in 2014 across the EU.

Similar to prices for the household segment, there are large cross-country variations in prices (VAT and other recoverable taxes excluded) for industrial consumers across the EU. In 2014, the lowest estimated industrial price in consumption band I4 ((27,780 MWh < consumption < 277,800 MWh) was in Belgium (2.69 Eurocent/kWh), with the highest price in Greece (4.30 Eurocent/kWh), producing a price differential ratio of 1.74 between the cheapest and the most expensive Member State of the EU. This ratio has decreased from 2.28 in 2007, indicating a gradual convergence of industrial prices.

Gas prices for industry on average increased by 34 per cent between 2007 and 2014. However, when compared to 2013, retail prices for industrial consumers on average fell by 8 per cent across the EU, resulting in a price differential ratio of 1.48 between the cheapest and the most expensive Member State in the EU. The wholesale price differential across the EU is lower for gas markets as compared to electricity markets.

Average wholesale gas prices ranged from 25.27 €/MWh in Hungary to 37.45 €/MWh in Lithuania (2013 data). Wholesale prices fell on average by 4 per cent across the EU between 2012 and 2013.

Significant gas price mark-ups were seen in 10 Member States in 2013 (although price mark-ups are much lower in gas markets when compared to electricity markets). In the UK and Luxembourg, mark-ups of more than 60 per cent over wholesale prices were recorded in 2013. Negative mark-up rates were noted in Romania, Poland, Lithuania, Hungary, Poland and Slovakia. These Member States are characterised by retail gas price regulation.

Data for gas price mark-ups is only available for two years: 2012 and 2013. During this period, **the average gas price mark-up has fallen from 6.72 €/MWh to 4.81 €/MWh**. The largest fall was observed in Finland, Estonia, Portugal, Slovenia and Belgium.

3.2.6 Switching

Switching rate among gas consumers is relatively low at 5 per cent (EU average). Higher switching rates are noted in Ireland, the Netherlands, Spain and Belgium (a similar country trend as seen in the electricity market).

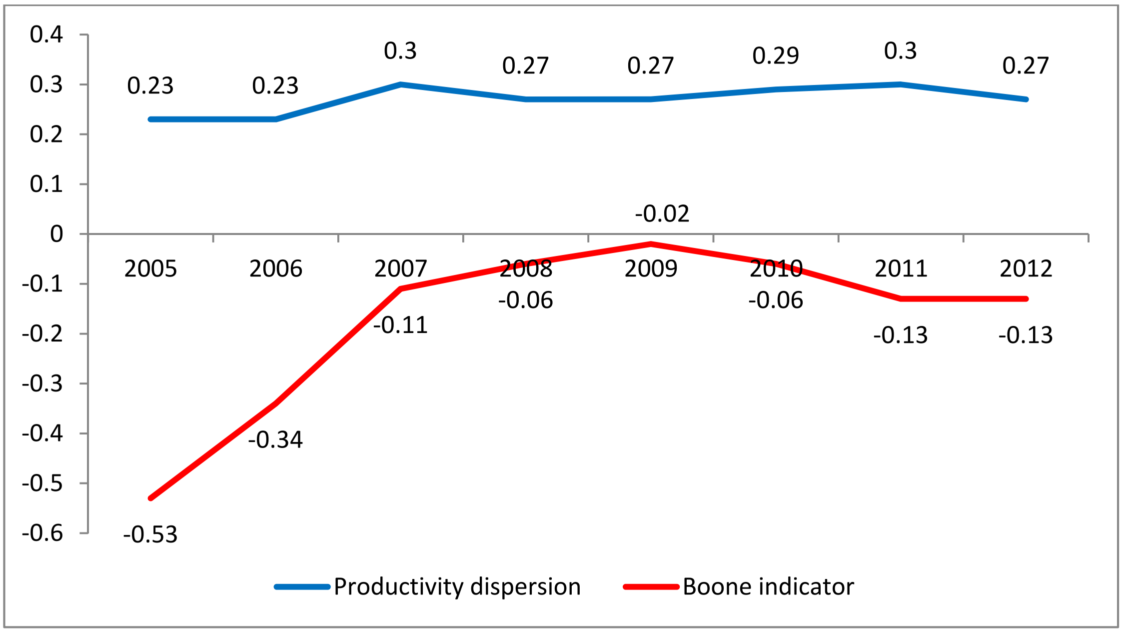
3.3 Intensity of competition in European energy markets

We calculated the following two indicators to assess the intensity of competition in the energy markets:

- **Productivity dispersion**, an indicator of how far competition drives productivity within a market by forcing inefficient firms to exit and allowing more efficient firms to enter. Lower levels of productivity dispersion are typically associated with a more competitive market (this indicator is explained in more detail in Section 5.2 of the Technical Report).
- The **Boone indicator,** a measure of degree of competition calculated as the elasticity of relative profits with respect to relative costs. The main idea behind this indicator is that competition rewards efficiency. In other words, competition leads to a transfer of profits towards relatively more efficient firms (those with lower marginal costs) at the expense of less efficient ones. Therefore, the more negative the Boone indicator, the higher the degree of competition is (because the effect of reallocation is stronger). The calculation of the Boone indicator is further explained in section 5 of the Technical Report.

Our analysis shows that productivity dispersion has remained stable overtime, although the Boone indicator has been relatively more volatile, suggesting a fall in the intensity of competition in European energy markets between 2005 and 2012 (Figure 3.2).

Figure 3.2 Competition measures over time



DIW's estimations based on the Amadeus/Osiris database. The Figure above shows mean values based on available data (covering 18 Member States)

3.4 Summary of key findings

The main observations that can be drawn from the data presented in this section are as follows:

- Overall European gas and electricity markets remain highly concentrated, although there are significant differences at a national level. Particularly high levels of market concentration can be observed in small countries such as Bulgaria, Cyprus Estonia and Malta. Member States such as Germany, Finland, Italy, Netherlands and the United Kingdom, on the other hand, exhibit relatively low levels of market concentration.
- While progress has been made in liberalising markets, the positon varies across Member States:
    - Many Member States continue to regulate end-user prices and there is still insufficient separation of infrastructure and supply functions in energy markets.
    - Although the level of vertical integration has- on average – been declining across the EU over the last decade or so, it remains reasonably high, particularly in gas markets.
    - Public ownership of the first generation producer remains high in many Member States in both gas and electricity markets.
- Wholesale prices have declined significantly for electricity and remained stable for gas.
- Gas and electricity prices have been rising for consumers (except in 2014 when prices fell) and high levels of mark-ups can be observed in a number of Member States.

- Productivity dispersion has remained stable overtime, although the Boone indicator suggests that the intensity of competition in European energy markets has declined between 2005 and 2012.
- Switching levels are generally very low across Europe, with the exception of a handful of Member States.

Alongside the above market developments, one can also observe an increase in EU competition policy enforcement activity overtime and particularly since 2000. The extent to which there is correlation or causality between some of the market developments noted above and EU competition policy enforcement is examined in the next section using econometric approaches. An interesting point to note is the divergence between retail and wholesale prices. In some Member States, this price divergence could potentially be attributed to factors which cannot be influenced by competition policy (such as rising taxes and network costs, and the continued regulation of energy prices to many European households), but it could also be indicative of markets not working well. The case study presented in section 5 specifically examines the relationship between wholesale and retail prices in the German electricity market in the context of a specific Commission Decision addressing alleged abuse of dominant position by E.ON.

4 Broad econometric analysis

The main objective of this study is to analyse the impact of the European Commission's competition policy enforcement activities on the functioning of EU gas and electricity markets. To achieve this, a broad econometric analysis was carried out to empirically examine the impact of EU (as well as national) competition policy enforcement on:

- The intensity of competition in energy markets, as measured by elasticity of relative profits with respect to relative costs (Boone indicator) and productivity dispersion.
- Medium and long-term outcomes such as investment and productivity.

We chose not to focus on short-run measures such as wholesale or retail prices as part of the broad econometric analysis because the case studies focus on these variables.

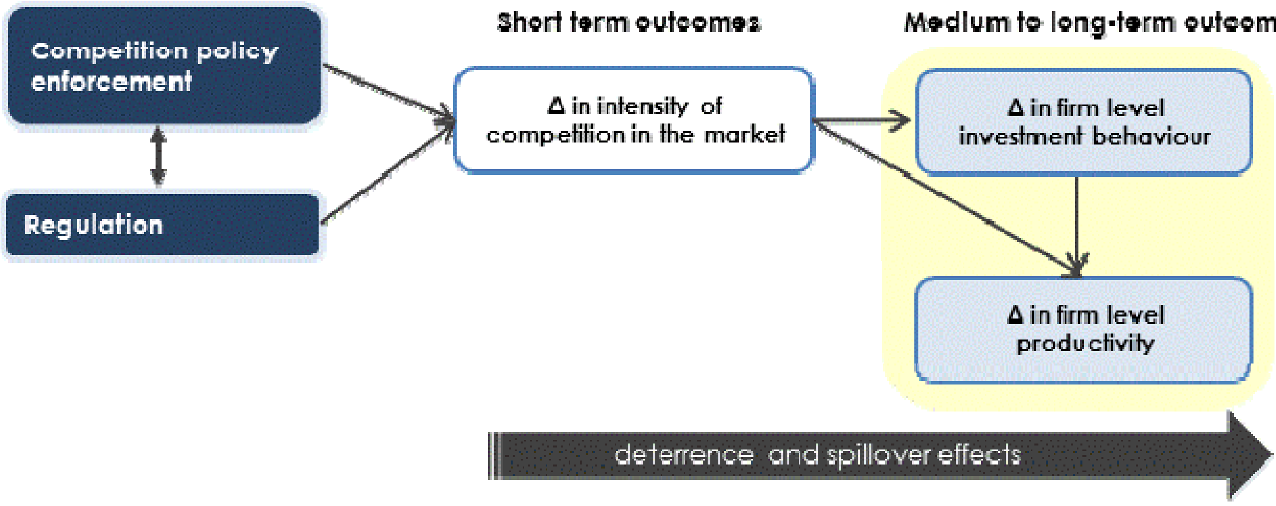
Additionally, our analysis also looks at the interaction between competition policy enforcement and regulation in energy markets. The remainder of this section describes our approach and results in further detail.

4.1 Underlying theoretical framework for the econometric analysis

The theoretical framework underpinning the empirical analysis postulates the following relationship between policy enforcement – i.e., competition policy and regulatory interventions— and market outcomes (Figure 4.1):

- Competition policy enforcement has a direct impact on the strategic interactions between firms in the involved markets, hence affecting competition.
- As a result of changes in competitive pressure, firms adapt their investment behaviour. We specifically chose investment as an outcome variable because there are many studies showing that firms facing stronger competition make substantial investments to improve productivity (Holmes and Schmitz, 2010). Moreover, investment is particularly relevant and interesting as an outcome variable in the energy markets. It is widely accepted that more investment is needed in Europe's energy sector to ensure security of supply and to improve efficiency. To meet the EU's ambitious climate and energy targets and at the same time secure the provision of energy, Member States are expected to increasingly invest in electricity generation, especially in renewable energies, as well as in electricity grids and natural gas infrastructure (e.g., Hirschhausen et al., 2014). Especially to incentivise investments in cross-national infrastructure projects such as interconnector transmission grids, but also in order to spur national investment in generation capacity, market and regulatory conditions are key. Measures of investments are therefore pivotal variables to look at when trying to understand how competition and regulatory policies affect energy markets.
- Changes in market competition and firms' investment behaviours in turn have an impact on outcomes such as firms' productivity. According to the literature, there are three main channels through which higher competition could lead to higher productivity: (i) within firms, competition acts as a disciplining device, placing pressure on the managers of firms to become more efficient. This is sometimes called the 'within-firm' effect; (ii) competition increases productivity by forcing inefficient firms to exit, by allowing more efficient firms to enter, and by reallocating resources from inefficient to efficient firms. market forces may cause inefficient firms to exit and may cause a reallocation in market shares from inefficient to efficient firms. These effects are generally called the 'between-firms effects'; and (iii) competition drives firms to innovate. Innovation increases dynamic efficiency through technological improvements of production processes, or the creation of new products and services.

Figure 4.1 Theoretical framework underpinning the broad econometric analysis



Source: own figure

There is another, indirect channel through which policy enforcement affects long-term market outcomes. Each specific policy intervention affects the firms and markets directly involved in the specific case, and also has important indirect effects in the form of spill-overs across (vertical) markets, and acts as a deterrent. . For example, specific policy decisions affecting investment in electricity generation capacity also likely affect incentives and market outcomes in transmission and distribution. Enforcing antitrust rules sends signals about the power of the antitrust authorities. Consequently, a particular decision affects both the firms involved in the case concerned, and other firms' behaviour in the same and related markets. These indirect effects are recognised as important elements of competition policy enforcement in literature.

Regarding the impact of regulation, there is evidence that regulation in product markets affects market outcomes and investment. No investigation thus far has considered how competition policy and regulation interact in determining competition and market outcomes.

4.2 Data and variables used for the analysis

To perform our econometric analysis we collected and constructed data on competition policy enforcement (our main explanatory variables), and measures of regulation, competition and market outcomes. The following indicators and data sources were used for the analysis:

EU competition policy enforcement data

To quantify the Commission's enforcement activities, we compiled a detailed dataset on EU competition policy enforcement between 2005 and 2013 in energy markets, comprising 200 merger decisions, 17 antitrust decisions (16 abuses and 1 cartel case), and 203 state aid. A distinction was drawn between 'activity' (i.e. the number of cases handled) and 'intervention':

- In merger cases, 'intervention' was defined as follows: remedies (in phase 1 or phase 2) and merger withdrawals during phase 2; no merger was prohibited during the sample period in the energy sector.
- In the case of state aid, an intervention was defined as the decision to initiate a formal investigation.
- For abuses and cartels, we simply use the number of cases as a measure of intervention, since all cases led to remedies or fines.

National competition policy enforcement data

Since this data is not readily available, a questionnaire was sent to all national competition authorities in the EU to collect this information. On the basis of the responses received, we constructed measures of national competition policy enforcement in a similar fashion as we did for the EU (bearing in mind that there are no state aid cases at the national level).

Control variables

The following datasets were used create the control variables:

- OECD Indicators of the Product Market Regulation project, specifically the indicators of regulation in energy, transport and communication (ETCR) described in section 3.2;
- Country specific data on GDP per capita, population growth and energy imports as a share of total energy consumption sourced from the World Bank;
- Country specific data on the energy mix sourced from DG Energy's factsheets.

The OECD indicators of Product Market Regulation were used to classify countries as high- or low-regulated. Further detail on our approach including the country classification can be found in section 5.1 of the Technical Report.

Outcome variables

In line with the framework illustrated in Figure 4.1, we constructed the following outcome variables:

- At the sector level, we created two measures of intensity of competition:
  - Elasticity of relative profits with respect to relative costs (Boone indicator); and
  - Productivity dispersion.

  These indicators have previously been described in section 3.3 of this report and are further detailed in section 5 of the Technical Report.
- At the firm-level, we constructed the two outcome variables (investment and total factor productivity) using data from Bureau van Dijk's Amadeus/Osiris database[12] :

4.3 Results the broad econometric analysis

Table 4.1 presents the main results of the broad econometric analysis. Detailed regression equations and results can be found in section 5 of the Technical Report.

Our analysis shows that EU merger control lowers both Boone's indicator and productivity dispersion; thereby indicating that national energy sectors became more competitive after these interventions. Moreover, EU merger control is significantly related to better market outcomes i.e. higher investment and higher total factor productivity. These findings are consistent with the reasoning that EU merger policy actions—through the channel of competition— induce energy firms to invest more, which ultimately leads to a higher productivity.

12 The database covers the period 1997-2014, but since data availability thins out considerably for the earlier and later periods, we only used the years 2005 to 2012. We focused on firms active in energy markets as represented by the NACE group D.35. The firms in the sample fall in the subgroups D35.1 (Electric power generation, transmission and distribution) and D35.2 (Manufacture of gas; distribution of gaseous fuels through mains). We performed our analysis for those firms that Amadeus classifies as 'very large', in order to focus on the sizeable players in the market. Only these firms are expected to engage in significant investment activities and to (strongly) react to changes in the regulatory and competitive environment. The chosen firms had a median of 117 employees and median fixed assets of around € 130 million

Table 4.1 Main results of the broad econometric analysis

	Boone 's Beta		Productivity dispersion		Investment		Productivity	
	Low regulation	High regulation	Low regulation	High regulation	Low regulation	High regulation	Low regulation	High regulation
Key EU merger decisions t-1	**-0.58***	-0.124	**-0.177***	-0.046	**0.226***	-0.006	**0.33***	0.061
	(-9.37)	(-1.07)	(-5.41)	(-0.25)	(2.90)	(-0.20)	(2.89)	(1.59)
EU State aid enforcement t-1	-0.010	0.004	0.028	-0.032	-	-0.008	-	-0.013
	(-0.28)	(0.06)	(1.43)	(-0.57)	-	(-0.38)	-	(-0.44)
EU abuse & cartel enforcement t-1	-0.187	-0.068	-0.040	0.197**	-0.265***	0.059**	-0.017	-0.025
	(-1.39)	(-1.11)	(-0.36)	(2.52)	(-2.60)	(2.29)	(-0.11)	(-0.71)
National merger enforcement t-1	0.035	0.080	0.000	-0.059	0.002	0.005	0.058	0.015
	(0.44)	(1.28)	(0.00)	(-1.17)	(0.05)	(0.26)	(1.03)	(0.49)
National cartel fines t-1	0.098	0.018	-0.084*	0.001	-0.038	-0.018	0.211	0.003
	(1.11)	(0.32)	(-1.96)	(0.02)	(-0.34)	(-1.01)	(1.19)	(0.14)
National abuse & cartel enforcement t-1	0.253	-0.905**	0.006	-0.077	-	-	-	-
	(1.17)	(-2.49)	(0.07)	(-0.46)	-	-	-	-
R squared	0.61	0.39	0.40	0.51	0.18	0.21	0.22	0.33
N	129	130	157	162	4,098	4,246	2,143	2,082

Source: DIW's analysis

These results are however, only present in low-regulated sectors. This finding supports the view that competition policy is mostly effective where the competitive process is not influenced by existence of high levels of regulation. For example, if investment is regulated then a different market structure will not change investment. If, on the other hand, it is not, then a different market structure may induce different behaviour from market participants. According to this logic, regulation and competition are substitutes. Indeed, once an industry has reached a particular threshold of deregulation, then competition should be introduced and further safeguarded through competition policy. Competition policy's role and impact should therefore be higher in low-regulated industries. Therefore, as regulation is lowered over time, competition should be gradually introduced. Competition policy, of course, should then also be strengthened to preserve competition (Bergman et al, 1998). While this time dimension has not been the subject of the current study, this would be an interesting issue to further explore. The empirical results for state aid and anti-trust interventions are much less robust, and hence no clear picture emerges.

4.4 Caveats and limitations of the analysis

Two important caveats should be mentioned:

- Although state aid notifications and antitrust enforcement do not have a statistically significant impact on market outcomes, they cannot conclusively be seen as ineffective. It is possible that their lack of numbers did not allow us to empirically identify consistent relationships.
- Causal inferences should be treated carefully. While we tried to deal with issues such as reverse causality bias (by lagging the policy variables) and omitted variable bias (by using fixed effects as well as other controls), our identification strategy is not based on a clear source of exogenous variation since it is virtually impossible to find exogenous variation in such a broad and heterogeneous framework. Therefore, we cautiously interpret our results as illustrating strong correlations between EU merger control and market outcomes rather than truly causal links.

5 Case study: E.ON's alleged abuse of dominant position in the German wholesale electricity market

To complement the broad econometric analysis, we did a detailed analysis of the effects of an antitrust enforcement case, namely E.ON's alleged abuse of dominant position in the German electricity market.

As mentioned earlier, in 2008, the European Commission investigated claims that E.ON allegedly withdrew available generation capacity from the German wholesale electricity market to raise prices and to deter new investors in generation. In response, E.ON agreed to divest a total of 5000MW of generation capacity. While the Commission Decision was announced at the end of 2008, the remedies were implemented over subsequent years. Specifically, the various plants were sold to different buyers between January 2009 and January 2010.

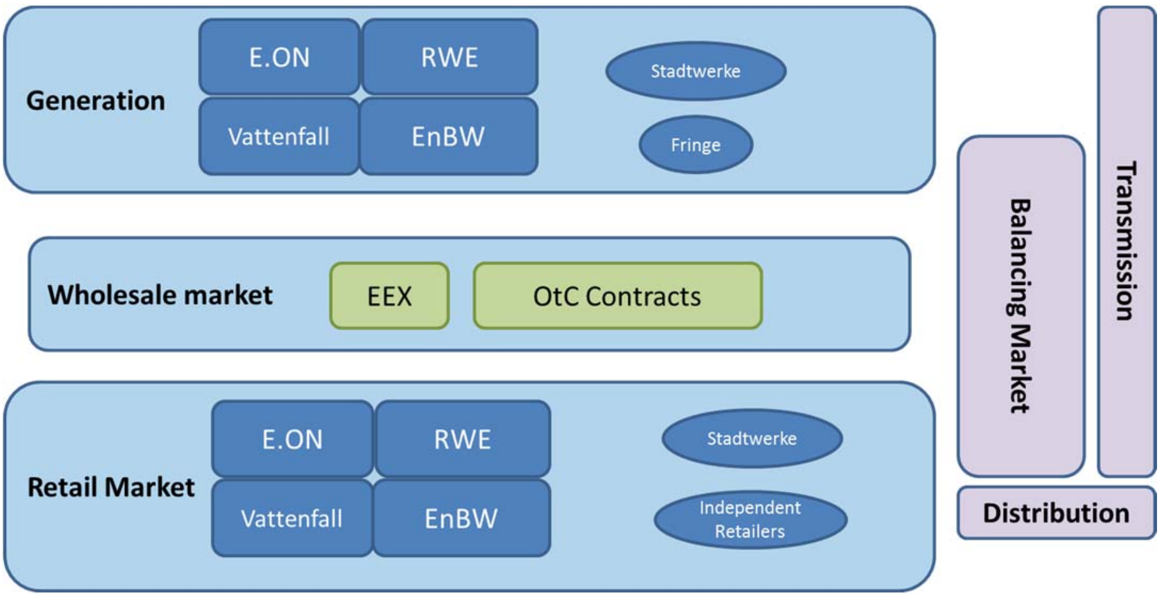
The Commission also raised concern that E.ON may have favoured its production affiliate for providing balancing services, while passing the resulting costs on to consumers, preventing other power producers from exporting balancing energy into its transmission zone. To address the Commission's concerns in the electricity balancing market, E.ON committed to divest its extra-high voltage network. The divestiture of E.ON balancing net also took place in early 2010.

Cumulatively, the Commission Decision(s) affected two main product markets: the wholesale German energy market and the balancing energy market. Although the effect of unbundling in the balancing market could have been important, based on existing evidence on the relationship between these two markets, we consider it of second order when compared to the direct abuse in the wholesale market. Therefore, in this case study, we focus on the evaluation of the first part of the Decision, i.e. the alleged abuse of dominant position in the wholesale electricity market. But we cannot clearly separate the effects in the two markets (wholesale and balancing) and what we empirically measure is the cumulative effect of all remedies imposed in the Decision.

5.1 Contextual overview of the German electricity market

The German market is characterised by a vertical structure comprising a generation segment, a wholesale market, and retail markets (see Figure 5.1). A transmission system assures that energy generated or imported is delivered to regional supply companies, which then distribute it via low or medium voltage networks to energy retailers and final customers. Finally, a parallel balancing market ensures that the necessary tension is present in the network at any given time.

Figure 5.1 The Structure of the German Electricity Market



Source: own figure

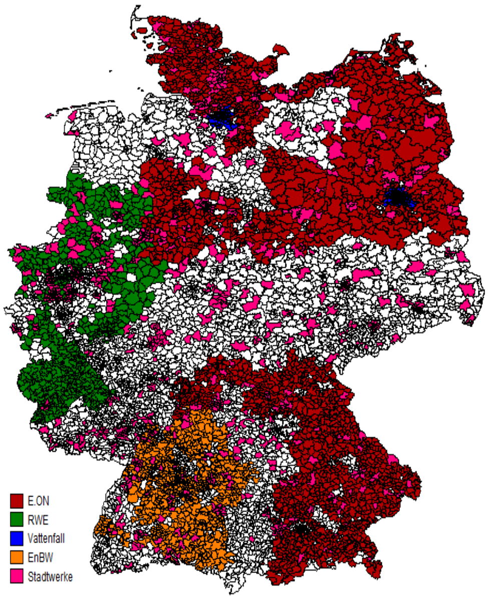
The generation segment is Germany is dominated by four vertically integrated, although legally unbundled, big players: E.ON, RWE, Energie Baden-Württemberg (EnBW), and Vattenfall, also the main players in the retail market and owners of a large part of the network. These operators jointly meet 2/3–3/4 of the total German electricity demand. The rest of the German energy needs are covered by local production by a large number of municipal operators ('Stadtwerke') and other smaller producers, or it is imported from abroad.

Regarding the wholesale market, most of the generated electricity is either passed on internally to the retail outlets of the vertically integrated producers or sold to other retailers via bilateral, over-the-counter (OTC) contracts and through a centralised energy exchange market. Since 2002, the German wholesale energy market has been at least partially, determined through the European Energy Exchange (EEX) market located in Leipzig. Most energy trade between wholesalers and retailers in Germany is however still performed by means of OTC long-term bilateral contracts between producers and suppliers, with only a minor albeit increasing percentage of energy trade covered through the EEX. According to the German Competition authority – the Bundeskartellamt (BKartA) – the German wholesale electricity market is characterised by joint dominance by the four big players mentioned above.

The German retail energy market is fairly concentrated. The 'big four' cover almost half of national demand. However, energy markets are regional and defined by coverage areas ('Versorgungsgebiete'). They differ substantially in terms of market structure, level of competition and, accordingly, retail prices.

In particular, the four big players upstream are also downstream incumbents ('Grundversorger') in various regions. But several of the small vertically integrated operators (particularly the 'Stadwerke') are also incumbents in different regional markets, generally in the municipalities where they operate. Figure 5.2 represents the geographical dispersion of these vertically integrated operators. The white spots represent coverage areas where the incumbent is either an independent and non-integrated operator or has a mixed ownership structure and it is partially owned by one or more of the big players and or one municipal firm.

Figure 5.2 Incumbents in regional retail markets in Germany in 2010



Source: Own calculations based on Verivox data.

In each region, several retailers offer different tariffs, incumbent operators are legally obliged to sell energy at a baseline tariff ('Grundversorgungstarif') to all household customers who do not explicitly choose another provider. Accordingly, this baseline tariff constitutes an upper bound for the energy retail prices in a given region because customers unwilling or lacking the information to switch supplier chose it by default. Incumbent operators consequently have particularly high market power over their customers and these tariffs are likely to be less responsive to changes in wholesale tariffs compared to those offered by the competitive fringe to more informed customers with lower switching costs in that region.

Even though each retailer has non-discriminatory access to all customers in every regional market and every customer has the choice of sometimes hundreds of operators in each regional, there is very little switching among household customers in Germany. In 2009, incumbent operators still served more than 70 per cent of the households in most German regional markets (Bundesnetzagentur, Monitorbericht (2009)). Moreover, most of these customers (on average more than 65 per cent) are still served at the most expensive baseline tariff.

The heterogeneity in energy purchase costs, consumer switching behaviour, and network costs results in significant price dispersion within local markets. Typically, the most expensive tariff is the baseline tariff offered by the local incumbent, while the cheapest alternative tariffs are typically offered by the smaller competitors.

5.2 Overall approach to the analysis

We focused our empirical analysis on two levels:

Wholesale prices: since E.ON's alleged abuse of dominant position directly affected wholesale markets, we consider the impact of the Commission's Decision on wholesale electricity prices in Germany. Specifically, we used wholesale prices as determined through the EEX market located in Leipzig. EEX prices are relevant to the analysis because they are readily available, transparent, and are used extensively in the literature on energy markets. A potential issue with using EEX prices is that most energy trade between wholesalers and retailers in Germany operates via OTC long-term bilateral contracts between producers and suppliers, while only a small (though increasing) percentage of energy trade is covered through the EEX. Because OTC prices should at least correlate with the EEX prices that constitute a sort of benchmark or opportunity cost for energy trading, but analysing the evolution of EEX prices would likely represent the effect of competition on upstream energy markets.

Retail prices: although the Commission's Decision only concerned the wholesale markets, we also examined the impact of the Decision on retail prices to discover whether the beneficial effects of competition in wholesale markets were eventually passed downstream. The level of pass-through between wholesale and retail prices depends on several factors:

- As mentioned earlier, three main types of energy retailers are active in the German markets: large, vertically integrated incumbents, municipal firms, and small, independent retailers. Energy suppliers differ structurally in the degree of vertical integration between different segments, their size, geographical scale, ownership structure, and objectives. These differences affect their energy purchasing strategies and, particularly, the type and length of their long-term contracts with wholesalers. Therefore, heterogeneous retailers have different incentives to pass-on upstream savings to downstream markets. Specifically, large, vertically integrated incumbents have less incentive to quickly pass-on upstream savings as compared to small, non-vertically integrated incumbents.
- The pass-through of wholesale price reductions to retail tariffs depends on the extent of downstream market power. Customer inertia, particularly among private households, creates a stable customer base for incumbent retailers, which can be exploited with high tariffs. Incumbent firms are therefore less likely to pass-on reduced wholesale energy costs than other competitors.
- Most contracts between energy suppliers and retailers are long-term. Therefore, if at all, the impact of the Commission's Decision on retail prices will probably take effect gradually as existing supply contracts are replaced by new ones. Hence, slow changes in retail prices following changes in wholesale prices are likely.
- Finally, other important factors such as the (mostly regulated) cost of transmission and distribution and taxes affect retail prices. Wholesale energy prices constitute only a small part – in Germany ca. one third - of retail tariffs. This implies that regional and temporal variability in retail prices might be explained by these other factors (carefully controlled for in our analysis).

A unique dataset from German price comparison site Verivox was used for the retail level analysis, with monthly price data between 2007 and 2014 for more than 8,000 zip codes by more than 800 electricity providers. We differentiate between three different types of household consumption (annual consumption: 1,500 kWh, 2,800 kWh, 4,000 kWh) and one typical commercial costumer (10,000 kWh).

5.2.1 The choice of methodology

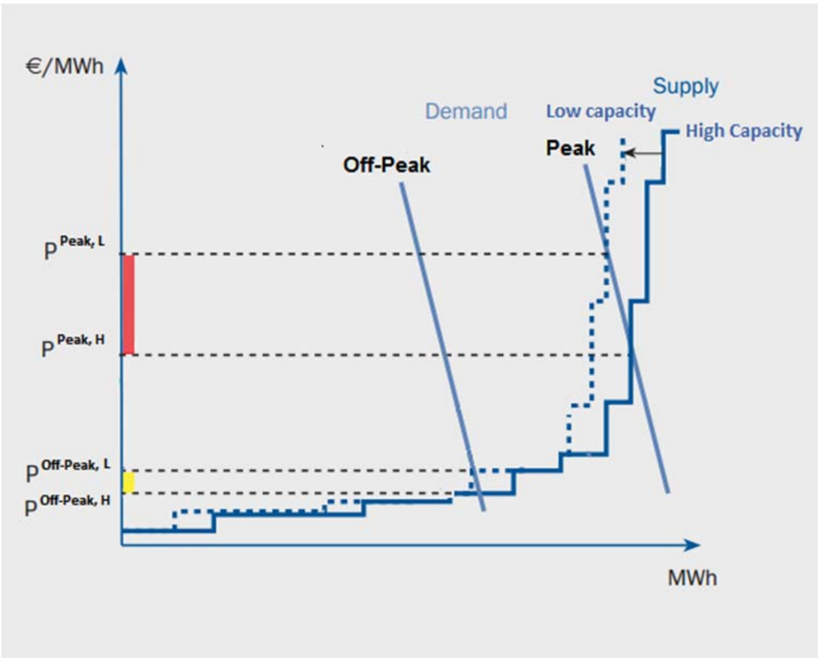
We used a Difference –in- Difference (DiD) approach to identify the effects of the EU antitrust enforcement Decision. This methodology involved looking at markets/firms/products that are similar to those affected by the conduct and the subsequent policy decision ("treated group") but which had themselves not been affected ("control group") or, at least, had been less affected. The identification strategy exploited both time and cross sectional variation in the main outcome variables (wholesale and retail prices) to identify the effects of the Decision. We compared the differences in the average behaviour and outcomes of the treated group, before and after the abusive conduct and the Commission's Decision had been observed, with the difference in the average behaviour of the control group, during the same period. This double differencing removes the time invariant individual effects (of treatment and control group) and the common time effects that might be otherwise confounded with the effect of the conduct and Commission Decision. It enabled the identification of the average causal effect of these actions. The two main issues for identification of the causal effects were 1) the choice of the counterfactual (treated vs. control groups) and 2) the choice of the before-and-after periods. These issues are explained below.

5.3 Analysis of the wholesale market

5.3.1 Identification of the "control group"

We looked at two different outcomes in Germany, the on-peak and off-peak wholesale electricity prices, which should have been differently affected by the Commission's Decision. The underlying idea is that energy suppliers have more market power during peak periods when demand is higher due to business activities. Since the supply schedule is highly convex and much steeper in the peak period, a shift to a lower capacity schedule obtained if capacity is withdrawn from the market would have a bigger effects during peak time. The difference in the peak price between the high capacity scenario ($P^{Peak,H}$) and the low capacity scenario ($P^{Peak,L}$) is much larger than the difference in the off-peak price between the high capacity scenario ($P^{Off\text{-}Peak,H}$) and the low capacity scenario ($P^{Off\text{-}Peak,L}$). Therefore, a policy intervention that shifts the supply schedule to the 'high capacity' scenario should most critically reduce market power, and hence prices, during peak hours while having much smaller effects during off-peak times (0).

Figure 5.3 Differential Effect of a shift in Supply Peak vs. Off-Peak Prices



Source: own figure

We decided against alternative ways of defining the control group based on cross-country comparisons.

First, we considered choosing a country structurally similar to Germany but not impacted by any abuse, merger, or other relevant competition policy decision during the sample period as comparator. But it was impossible find a truly comparable national market because Germany has an unusual electricity market mainly because it pursued a unique 'green-strategy' (the so-called '*Energiewende*'). Direct neighbours are also a poor counterfactual because electricity markets are becoming more connected and cannot be seen as fully independent. Finally even markets not strongly connected would be a poor counterfactual if they have been affected by some competition policy interventions during the sample period.

A second approach relied on the creation of a so-called synthetic control group' which consists of creating a synthetic, hypothetical market, whose outcome pre-treatment is an almost perfect match for the outcome of the treated group. In our case, this 'synthetic group' could be constructed as a weighted average from a selection of other countries and representing Germany as it would be, had it not been subject to the Commission's Decision.

The difficulty here lies in the selection of suitable countries to be included in the creation of the control group. Moreover, this approach is data intensive, potentially depending on a large set of key control variables that affect the outcome variable, i.e. energy prices for both Germany and all other countries used in the control group.

In a substantial data collection exercise, we gathered almost complete information on wholesale prices and their drivers for Belgium, Czech Republic, Denmark, France, Switzerland, Netherlands, Poland and Sweden. We then tried to generate a synthetic control group for the two German prices (peak and off-peak) using several variables such as energy consumption, temperature, and holidays as observable characteristics. Because we could not satisfactorily match German electricity prices using the synthetic control group[13], this approach was eventually abandoned.

5.3.2 Identification of “before” and “after” period

The following time periods were considered relevant to the analysis: the ‘before’ period (up to December 2008), the ‘implementation’ period when the remedies were implemented (January 2009 to April 2010), and the ‘after’ period (since May 2010). Given the high frequency of our data and because wholesale energy markets are very dynamic and should respond swiftly to changes in supply conditions, we considered four different impact scenarios to identify both the short-term and long-term effects of the policy intervention. The advantage of the short-run scenario is that they try to identify the effect of each single remedy and focus on very short time periods. Hence, the risk of contaminating the effect of the intervention with other, unobserved factors is much lower. However, the effects of an important policy intervention could be much more pervasive. Therefore, it is reasonable to look at the long-term impact of the decision over several years. The disadvantage of this is that the precise causal identification of the policy intervention might be weakened by the existence of confounding factors, particularly in such a liquid and dynamic market.

5.3.3 Results of the analysis

The results of the analysis at wholesale level are presented in Table 5.1. We find that wholesale electricity prices in Germany decreased on average by 7 to 20 €/ MWh following the Commission’s Decision in 2009. But this cannot be seen as the causal impact of the Decision. It is crucial for this study to check whether the divestitures reduced the difference between peak and off-peak prices, because this convergence is what we would expect if the Decision effectively reduced wholesalers’ market power. We find strong and statistically significant convergence effects in the short and long-run. The size of the effects is also economically very relevant, with convergence varying between 3 and15 €/MWh. The magnitude of price convergence is significant when considering that the average difference between peak and off peak prices was 30 €/MWh over the long run

These findings support the view that the Commission’s decision, by affecting competition in the EEX market, reduced wholesale prices.

[13] A synthetic control group would have been deemed reliable if the German pre-treatment prices were almost perfectly matched by the prices generated for the synthetic control group in the pre-treatment period.

Table 5.1 E.ON case: Impact of the Commission Decision on wholesale electricity prices in Germany

	Post 2010	Post 2009	Short-Run	Single Div.
Peak	30.84***	31.03***	19.68***	19.83***
	(1.89)	(1.79)	(1.00)	(1.03)
Peak × Post	-15.37***	-14.58***	-3.22**	
	(1.65)	(1.66)	(1.54)	
Peak × Div. 1				-2.48
				(2.65)
Peak × Div. 2				-4.47***
				(1.62)
Peak × Div. 3				0.18
				(2.28)
Peak × Div. 4				3.57
				(3.25)
Peak × Div. 5				-2.40**
				(1.19)
Peak × Div. 6				-9.55***
				(2.16)
Peak × Div. 7				-4.37***
				(1.31)
Peak × Div. 8				-6.54***
				(2.27)
Constant	40.32***	38.38***	46.66***	47.89***
	(7.46)	(6.33)	(7.92)	(8.24)
Cumulative post effect (long run)	-7.09***	-11.85***	-20.06***	-20.84***
	(2.74)	(4.30)	(4.97)	(5.62)
N	2190	2916	2890	2916
Adj. R^2	0.7800	0.7900	0.7626	0.7625

Source: DIW's analysis

5.3.4 Robustness check: Placebo regressions using France and Spain

To verify the reliability of our results, we performed several robustness checks. The most important one is based on the use of cross-country variation in the convergence between peak and off-peak prices.[14] Instead of using other countries as alternative control groups, we use them in a sort of 'placebo' scenario. We selected two countries that share some similarities with Germany —France and Spain—where we have good data especially regarding the production of renewable energy and cross-border flows. These two countries have also the peculiarity of being more (France) or less (Spain) connected to Germany through common borders. We then implement the same identification strategy used for Germany on the French and Spanish prices, comparing peak and off-peak prices and using the same definition of the before and after periods.

If the chosen 'placebo' markets are independent from the German one and our divestiture dummies indeed identify the effect of the Commission's decision rather than other omitted factors, then we should not observe any significant results for the 'placebo' markets. However since the French electricity market is potentially more integrated to the German one than Spain, we might expect to observe some potential spill-over effects of the E.ON decision on French wholesale electricity prices. This approach is particularly useful to verify if our identification of the short-term effect of the remedies was accurate. Specifically, if we were to find significant results for the single divestiture in Spain, a country which should not be affected by the behaviour of the German market, then we could conclude that our

[14] Additionally, we performed other robustness checks to control how the way we model autocorrelation in the residuals –one of the main econometric issues we face by having high frequency, time-series data—affects our results. We show that the main findings are not affected by different modelling assumptions.

divestiture dummies are measuring some other shocks rather than the effect of the specific remedy.

In line with our expectations, we did not find any large and significant convergence effect in both the short-term and long-terms specifications for Spain. The picture for France is more mixed, which is also consistent with our expectations. Generally, we do not observe that the integration between the German and the French market reaches such an extent that the observed short-term changes in German prices are matched by the French ones. Overall, these additional results provide additional evidence to our claim that we are able to identify the effect of the implementation of the remedies imposed by the Commission on E.ON and we are not measuring unrelated shocks affecting electricity markets.

5.4 Analysis of the retail market

5.4.1 Approach to the analysis

Given the structural characteristics of German retail electricity markets, our 'treatment' group (i.e. companies affected by the Commission decision) consisted of the three major incumbents (E.ON, RWE and EnBW and, potentially Vattenfall) whereas the 'control' group comprised the small, independent retailers. The logic behind this can be explained as follows:

- The German retail market can be broadly segmented into two groups of customers: (i) a group of captive customers who stick with the incumbent baseline tariff or perhaps another cheaper tariff of the incumbent and (ii) a more mobile group of customers willing to switch.
- The three major incumbents (E.ON, RWE and EnBW) can be expected to exert more market power than independent incumbents because they serve a larger fraction of the 'captive' customers with high switching costs.
- The three major incumbents (E.ON, RWE and EnBW) can also be expected to react less to changes in wholesale prices as compared to the small, independent retailers because they are vertically integrated and use a more conservative purchasing strategy in the wholesale markets. They tend to purchase more than 40 per cent of their sales volumes more than one year in advance and only c. 5 per cent in the year of delivery as opposed to new entrants purchase c. 35 per cent of their sales volume during the year of delivery (as reported by the German regulator, Bundesnetzagentur, (2011) p 41). The regulator notes that *'(…) Since a short-term purchasing strategy is currently on average cheaper than a long-term one, new entrant can offer at present more convenient conditions to their customers without losing money in supply and distribution.*'

We would expect the price level of the big three incumbents and price dispersion at a local level to be significantly higher in markets where E.ON, RWE and EnBW are incumbent operators, compared with markets with independent incumbents, after the remedies have been implemented.

Even if part of the effect of the Commission's Decision on wholesale prices is short-term and materialises soon after the individual remedies have been implemented, because energy is purchased via long-term contracts, we would expect a corresponding decrease in retail prices at the earliest several months after the enforcement of the intervention. We also expect the three major incumbents to react less swiftly to changes in wholesale prices relative to other firms given their purchasing strategy. We would therefore expect the effects the Commission's decision to slowly materialise over time following the implementation of the remedies.

5.4.2 Results of the analysis

We find that the Commission's Decision, by affecting wholesale tariffs, also had an impact on electricity prices downstream.

Overall, most retail prices significantly increased over the period 2008 to 2011. However, our analysis suggests that retail prices would have increased even further in the counterfactual scenario, i.e. in absence of the wholesale price reduction spurred by the Commission Decision (Table 5.1).

Specifically, we find strong and significant evidence that all retail tariffs and the within-area price dispersion — i.e., the difference between lowest and highest tariff— increased in areas where the incumbent was one of the big three energy incumbents (E.ON, RWE, EnBW) if compared to small independent firms (Table 5.2). For instance, the price increase for E.ON with respect to the independent incumbents in the 1,500 kWh consumption plan is € 5.512/MWh per year which represents 1.5 per cent of the average conditional annual expenses for that consumption plan (€346.7). The municipal firms, or 'Stadtwerke', seem to have reacted even more extremely than the (few) independent incumbents. Their baseline tariffs have significantly decreased with respect to that of the independent incumbent retailers and, clearly, to those of E.ON, RWE, EnBW, and Vattenfall. In the case of 1,500 kWh consumption plan, the price reduction post intervention compared to independent firms is by €5.85 per year and it represents ca. 1.7 per cent of the annual bill. Compared to E.ON, the reduction of the 'Stadtwerke' is therefore ca. €11/MWh and accounts for more than 3 per cent of the annual bill. These findings are consistent across different consumption plans and are even stronger for RWE.

Moreover, we find that these effects slowly materialised during the two years following the implementation of the Commission's remedies.

These results are thus, consistent with the observation that independent retailers and municipalities more substantially passed through wholesale price reductions to consumers than the major incumbents.

Table 5.2 E.ON case: Impact of changes in the wholesale market (resulting from the Commission Decision) on retail electricity prices, Incumbents' baseline tariff

	1,500 kWh		2,800 kWh		4,000 kWh		10,000 kWh	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
E.ON	-1.533	(3.941)	-1.991	(6.699)	1.606	(10.84)	-75.39*	(42.74)
RWE	-1.580	(3.436)	-0.539	(5.501)	21.38**	(9.612)	-14.66	(27.06)
EnBW	0.740	(9.060)	10.34	(9.469)	39.74***	(12.00)	312.7***	(48.37)
Vattenfall	-18.52***	(3.331)	-36.74***	(5.391)			-144.3***	(26.86)
Stadtwerke	0.179	(3.032)	-2.710	(5.108)	-0.105	(8.894)	-13.11	(26.19)
Other	5.821*	(3.321)	8.565	(5.365)	16.24*	(9.581)	0.507	(26.80)
E.ON × Post	5.512***	(1.118)	9.352***	(1.904)	2.192	(2.025)	39.84***	(7.955)
RWE × Post	7.760***	(1.113)	17.34***	(1.905)	15.96***	(2.023)	64.35***	(8.034)
EnBW × Post	0.143	(1.101)	3.560*	(1.884)	-3.667*	(2.005)	27.32***	(7.888)
Vattenfall × Post	-0.287	(1.235)	1.490	(2.123)	-27.02***	(2.010)	92.45***	(8.135)
Stadtwerke × Post	-5.849***	(1.141)	-9.910***	(1.948)	-21.52***	(2.095)	-32.68***	(8.213)
Other × Post	-0.111	(1.129)	-2.020	(1.922)	-17.93***	(2.126)	-12.60	(8.005)
Observations	480,496		482,231		480,496		479,906	
Adjusted R-squared	0.915		0.922		0.928		0.919	

Source: DIW's analysis

5.5 Caveats and limitations of the analysis

We would recommend a cautious interpretation of our results in terms of drawing a clear causal relationship between the Commission's Decision and electricity prices.

Even though we tried to exploit the specificities of electricity markets to very carefully design our empirical approach and set up our identification strategy, at both level of the analysis we cannot completely exclude that other relevant events which affected the functioning of markets might also be driver of the observed results. In both analyses we tried to identify these alternative channels and we were partially able to provide evidence that they played a less crucial role than the E.ON decision.

However, especially for what concerns retail markets, this is very difficult to do. Indeed, given that the Commission's decision only relates to wholesale markets, the impact of remedies can in principle only be assessed at this level. Hence, the retail market's analysis cannot be considered to be a true ex-post evaluation of the Commission's decision. The downstream analysis has the broader purpose to provide quantitative evidence of the potential implications of an antitrust decision on adjacent markets and shed lights on other important competitive aspects of electricity markets.

On the whole, we believe that the empirical regularities identified in this chapter provide consistent and convincing evidence that the Commission's decision had a key influence on the functioning of the German electricity markets after 2009 and brought some benefits to consumers.

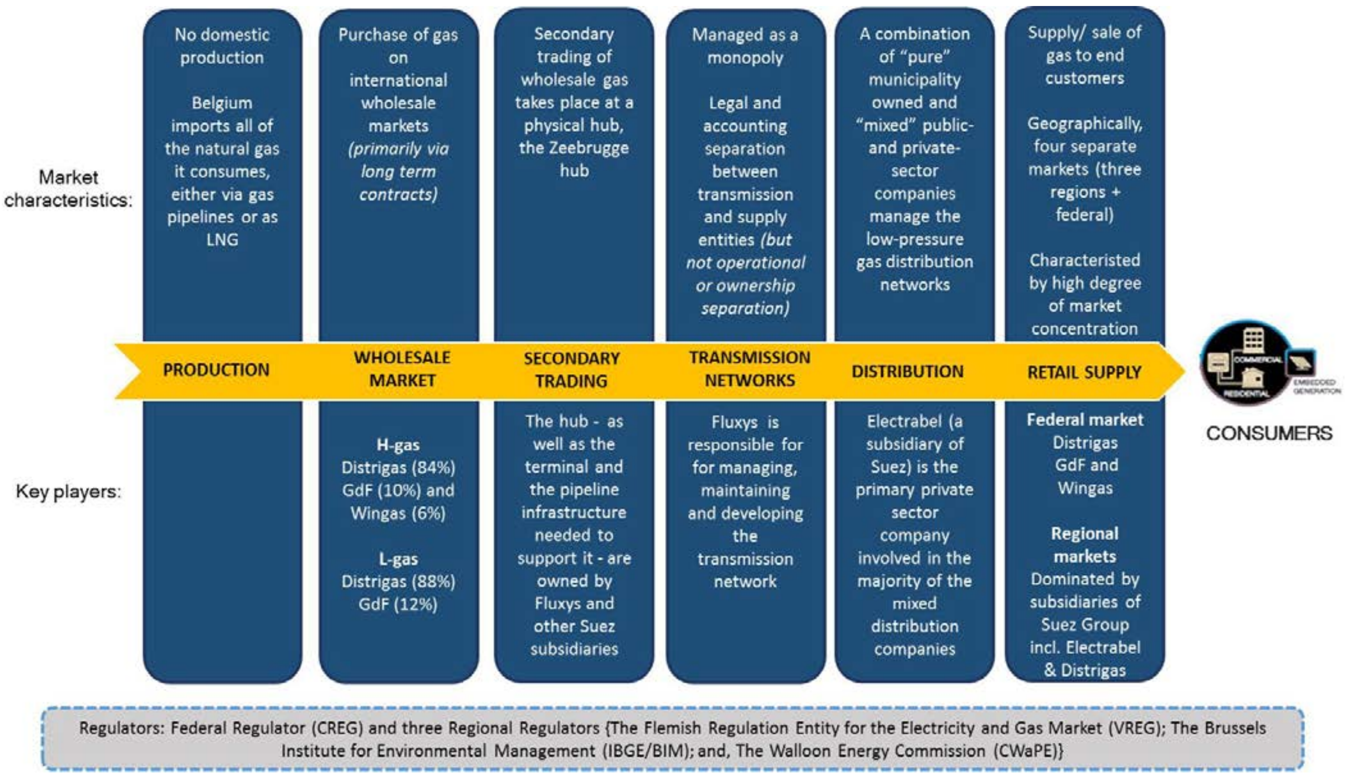
6 Case study: GDF / Suez merger

Gaz de France's (GDF) proposed acquisition of Suez in 2006 aimed to create one of the world's largest energy companies. The merger raised competition concerns in both, electricity and gas markets, and at several stages of the supply chain in Belgium as well in France. In Belgium in particular, there were horizontal and vertical competition concerns in the wholesale and supply segments of the gas market. In response to these competition concerns, both parties offered extensive remedies on the basis of which the merger was eventually approved by the Commission in November 2006.

6.1 Background to the case

At the time of the merger, the Suez group and its subsidiaries (notably, Distrigas, Fluxys, Electrabel) dominated the Belgian gas markets, operating across all segments of the supply chain as illustrated in Figure 6.1. Moreover, GDF was also a key player in the gas markets in Belgium as well as being active in the electricity market, with joint control (along with Centrica) over SPE – the second biggest player in the Belgian electricity market.

Figure 6.1 Stylised overview of the Belgian gas market before the merger



Based on information sourced from CREG Annual Reports (years 2005 and 2006) and Cambridge Economic Policy Associates (2008) Structure and functioning of the natural gas market in Belgium in a European context. Notes: (i) Belgium consumes two different types of natural gas, namely H-gas (with high caloric value) and L-gas (with low caloric value) (ii) Distrigas was previously known as Distrigaz (iii) the above diagram is a simplification and should not be seen as a comprehensive depiction of the Belgian gas market. For example, it does not include the storage segment of the supply chain

On 19 June 2006, the Commission initiated proceedings under Article 6(1)(c) of the Merger Regulation due to competition concerns. The Commission's ensuing investigation found that, given the horizontal and vertical overlaps between the two companies' activities, the proposed transaction raised significant competition concerns at all levels of the Belgian gas market.

At the wholesale level in gas markets, the Commission was concerned that the merger would significantly impede competition, because it would:

- Give the new entity (GDF Suez) control of most gas imports into Belgium through its ownership of Distrigas. This risked excluding competitors from downstream gas (and electricity) markets.
- Result in potential vertical problems due to the parties' control over essential infrastructure (such as the transmission and transit networks, and storage facilities). Their control over Fluxys (the network operator) would give the parties privileged access to supply infrastructure and storage.
- Fail to address the existing access issues to the Zeebrugge (ZEE) hub, with Distrigas & Co. (a subsidiary of Distrigas) possessing all rights of access to the hub (this meant non-transparent agreements with all hub customers negotiated on a bilateral basis). Parties wishing to access the hub only (but not the domestic transmission market) were still required to obtain capacity rights through an entry/exit agreement with Distrigas & Co. Distrigas was also a competitor (actual or potential) of the other market players, so its monopolistic role posed further problems to competition. In particular, the non-discriminatory treatment of information obtained by its control of access to the hub.

In response, GDF and Suez offered extensive remedies, including relinquishing control of Fluxys (the Belgian network operator), Distrigas & Co and the divestiture of Distrigas (and SPE). GDF and Suez also committed to a series of investment projects to increase infrastructure capacity. Together, these remedies were intended to facilitate entry of new competitors and foster competition. They were also intended to facilitate access to the hub, with the expectation this would increase liquidity and trading volumes, and lower prices at the hub. As a result, the Commission concluded that the merger would not significantly impede competition in the European Economic Area (EEA) or any substantial part of it.

6.2 Scope of the case study

This case study focuses on the Belgian gas market and specifically aims to quantitatively evaluate the price effects of the merger (the associated remedies approved by the European Commission) on the market for trading on the ZEE hub. The hub, as part of the Belgian gas wholesale market, suffered infrastructure access and liquidity issues before the merger. The negotiated remedies partially aimed to free up access to the hub, which, if effective, would have generated higher volumes of trade and relatively lower prices. The study also provides some post-merger insights into competition in the supply market.

The depth and breadth of the econometric analysis to evaluate this merger case was severely limited by non-availability of data. The econometric analysis therefore focuses on hub prices only. The study team searched for additional data from various sources such as CREG (Belgian regulator) and the firms involved (GDF, Suez and Fluxys), but Data additionally sourced from CREG and Fluxys was not suitable for econometric analysis and could only be used for descriptive analysis.

6.2.1 Key aspects of the merger

The table below provides an overview of GDF and Suez groups' interest in the Belgian gas market. The last row of the table shows the combined market share of the merging entities (with no divestitures or remedies). The merged entity – in absence of any remedies - would have acquired a dominant position in all segments of the gas supply chain in Belgium.

Table 6.1 Market shares of the Suez group and the Gaz de France group in the Belgian natural gas market in 2004, %

	Wholesale market		Supply market	Transmission / Transit networks	Distribution network
	H-gas	L-gas			
Suez	84.37 (Distrigas)	88.21 (Distrigas)	86.3 (Distrigas + ECS)	100 (Fluxys + Fluxys LNG + Distrigas & Co.)	76 (mixed distribution network operators)
Gaz de France	9.82 (GDF)	11.79 (GDF)	7.2 (GDF + Luminus + ALG Negoce)	0	0
Total (after merger)	94.19	100	93.5	100	76

Source: CREG. 2006.

In its assessment of the merger, the Commission defined the relevant markets as follows:

1. *The market for trading on the hub.* Based on price correlations, the Commission reached the conclusion that the trading market on the two hubs of Zeebrugge and the National Balancing Point (NBP, UK) belonged to the same geographic market. This was determined on the basis of a study undertaken by Ofgem[15], which assessed price differences between the hubs. The study found that prices at NBP and Zeebrugge were increasingly converging, with this trend was expected to continue with plans to increase the Interconnector's capacity. Notably important for this study (as later explained in this report) is the fact that on the basis of the same evidence, the ZEE hub was decided to be a geographically distinct market from the Title Transfer Facility (TTF hub) in the Netherlands. The Commission concluded the TTF did not form part of the same market as the price differences were more frequent and significant[16].

2. *The various gas-supply markets*. Based on surveys, the Commission decided to constitute separate markets according to the various categories of customers such as supply of H and L gas to dealers, large industrial customers and small industrial customers.

6.2.2 The merger remedies

The remedies, as per the Commission Decision, were composed of several elements. Those relevant to the Belgian gas market are summarised below:[17]

1. *Divesture of the Suez group's holding in Distrigas:* It was agreed that Suez would divest its holding in Distrigas to a third party.

2. *Restructuring of the activities of Fluxys s.a. and relinquishing of all control over the company.* Fluxys' activities were to be reorganised into two entities – Fluxys SA and Fluxys International. Fluxys International was to own the LNG terminal (and the non-regulated Belgian and international assets). Fluxys SA was to own the entire Belgian gas transmission and transit system and all the Belgian gas storage infrastructure. To this end, Suez would transfer to it Distrigas & Co (which marketed transit capacity on

15 Ofgem, the British Regulator, had undertaken a detailed analysis of prices, including transmission costs, during the period January 2000 to April 2006. Ofgem also undertook further analysis upon the request of the Commission to carry out the same analysis for the last 24 months i.e. the period July 2004 – June 2006.

16 Paragraph 99. Commission decision of 14 November 2006 declaring a concentration to be compatible with the common market and the EEA Agreement. Case No COMP/M.4180 Gaz de France/Suez.

17 Commission decision of 14 November 2006 declaring a concentration to be compatible with the common market and the EEA Agreement. Case No COMP/M.4180 Gaz de France/Suez.

the Troll and rTr routes). Fluxys SA was to be regulated under Belgian law. In the case of Fluxys SA, the parties also undertook not to hold more than 45% of the capital (with Publigas holding 45%). The parties further agreed not to hold more than 60% of the capital of Fluxys International SA.

3. *A series of additional measures relating to the gas infrastructures in Belgium.* The parties undertook to create a single point of entry at Zeebrugge which would bring together the hub, the LNG terminal, the point of arrival of the Interconnector Zeebrugge Terminal and the point of arrival of the Zeepipe terminal.
4. *Divesture of GDF's holding (via Segebel) in SPE.* GDF agreed to relinquish 50 per cent of its shareholding in Segebel, a company which itself had a 51 per cent shareholding in SPE's capital.

6.3 Descriptive analysis of the Belgian gas market post-merger

6.3.1 Changes in market structure and regulation

GDF Suez merger and corresponding remedies resulted in significant changes in the Belgian gas market and triggered the implementation of regulatory and strategic choices afterwards (implemented by the CREG). Table 6.2 provides a timeline of the key milestones following the GDF Suez merger.

Table 6.2 Timeline of key events

Timeline	Event
May 2006	The merger between GDF and Suez is proposed
Nov 2006	The Commission approves the merger with remedies
May 2008	Suez's sale of Distrigas to ENI. *This was the first part of the unbundling process. Due to this action, the vertical chain to its subsidiary Electrabel in retail markets was broken*
Jun 2008	The sale of of Distrigas & Co. to Fluxys *This action potentially opened the pipelines towards the hub for competitors, as GDF Suez could no longer control the physical gas flows into / out of the hub. On its own, this remedy would have been insufficient to open up competition in the hub as Fluxys International (controlling the hub via the Huberator) was still 60 per cent owned by GDF Suez. However, part of the ruling by the Commission was that the decisions in both Fluxys SA and Fluxys International would be taken by the same board (see next point below). Given that GDF Suez could only control 45 per cent of Fluxys SA, this meant that it could not dominate decisions in Fluxys International. This effectively meant Suez lost control over the functioning of all of Fluxys' operations*
Jul 2008	The partial sale of Fluxys by Suez which reduced the shareholding of the merged entity (GDF Suez) as follows: ▪ Fluxys SA (transmission and storage): 45 per cent ▪ Fluxys International (LNG Terminal, BBL, Huberator, GMSL): 60 per cent Moreover, it was agreed that decisions in Fluxys SA and Fluxys International would be taken by the same board.
Jul 2008	The newly created GDF Suez officially comes into existence
May 2009	Publigas (an organisation owned by local municipalities in Belgium) increases its share in Fluxys SA to 51.47 per cent and becomes the *de facto* owner of Fluxys
March 2010	A decision is taken by GDF Suez to sell its remaining stake in Fluxys to Publigas

Overall, the merger remedies implemented in 2008 led to an ownership 'unbundling' of the merged entity GDF Suez in the hub, the supply markets and the retail market. In particular, the transfer of Fluxys and the remaining assets underlying the physical structure of the Belgian gas market (such as transit, transmission, hub, LNG and storage) were essential for simplifying access to the Belgian gas markets.

The merger remedies were to a large extent supported by the national regulator CREG, who was also involved in their implementation. Interviews with CREG suggest that the merger remedies empowered the regulator to further push and bargain for more regulatory changes to improve the functioning of the Belgian gas market. These included:

- Introduction of pro-active congestion management systems;
- Reduction in the number of balancing zones from four to one;
- Implementation of a new Code of Conduct in June 2010 (CREG, 2010).

6.3.2 Trading at the ZEE Hub

The following positive developments can be observed at the ZEE hub, f the approval of the merger:

Improved access to the hub as evidenced by

- An increase in the number of participants at the hub: while increasing prior to 2006, the number of participants at the hub further rose from 68 in 2006 to 84 in 2014.
- A significant increase in traded volumes: the net traded volume increased from1,164 GWh in 2008 to a peak of 2,721 GWh in mid-2013.

Improved liquidity at the hub

Data sourced from Huberator shows that average daily net traded volume slightly increased with respect to the daily average physical throughput in the period following the merger (2008-2013).

6.3.3 Belgian supply markets

There were significant changes in market shares of various players in the Belgian gas supply market following the implementation of the merger remedies and consummation of the merger. The sale of Distrigas in 2008 to ENI accelerated a decline in its market share. GDF Suez on the other hand, increased its market share from about 13 per cent in 2008 to over 30 per cent in 2012. The number of companies active in the market increased from 20 in 2005 to 34 in 2012.

Distrigas' share of the sales volume (expressed as a proportion of the total volume in the Belgian market) significantly declined over the period 2005 to 2012, while its competitors expanded their market share from 2009 onwards.

Furthermore, across the supply market (aggregated over all types of customers), the number of active suppliers (or 'shippers') sharply increased post-2008, both for the L and H markets.

6.4 Empirical analysis: the market for trading on the ZEE hub

While the above descriptive analysis provides an indication of the changes that occurred following the approval of the merger, it does not tell us the extent to which these changes can be attributed to the merger decision (if at all). We therefore, conducted an econometric analysis to quantify the effects of the merger (and the associated remedies approved by the European Commission) on wholesale gas prices at the ZEE hub. It was not possible to conduct this analysis at a retail level due to lack of data.

Studying the impact of the merger (and its associated remedies) on the market for trading on the ZEE hub is highly relevant for an ex-post study as one of the main objectives of the remedies was to remove barriers to entry and facilitate access to the hub. A lower degree of market power, i.e. better access and liquidity at the hub could be expected to lead to an increase in trading volumes and lower prices. Thus, our main variable of interest was wholesale day ahead gas prices at the ZEE hub, time series data which is available through the Platts database.

This was a complex undertaking due to a range of structural remedies imposed, as well as other simultaneous changes to the structure of the Belgian gas market triggered by the GDF Suez merger.

6.4.1 Overall approach

A Difference in Difference (DiD) analysis was undertaken to compare prices at the ZEE hub with prices at a different hub taken as a control. Similar to any ex-post evaluation exercise, the robustness of the identification strategy crucially depends on a suitable control group. In a DiD exercise, the control group represents what would have happened to the treated group had the event not taken place. Ideally, then, it should be: i) unaffected by the event; and ii) as similar as possible to the treated group. Identifying a suitable control group is a problem for this this case. First, European hubs are, to an extent, interconnected, making it difficult to rule out that a major event affecting one hub might impact another hub. Second, it is hard to identify and control for all the events that may virtually impact wholesale prices, both at the ZEE hub and other hubs.

Given the above, the TTF hub in the Netherlands was identified the most suitable.[18] The reasons for this are:

1. At the time of the merger decision, the ZEE hub and the TTF hub were the two largest hubs (in terms of liquidity) in continental Europe[19].
2. The degree of interconnection between the ZEE hub and the TTF hub was very low at the time of the decision, and the European Commission[20] considered that they belonged to different markets.
3. There are few hubs for which data on prices are available from the mid-2000s.[21]

One may argue that the two hubs are not comparable as the ZEE hub is a physical hub (i.e. where the gas physically passes through the hub) whereas the TTF hub is a virtual hub (i.e. where gas enters only virtually after entering into a national system). However, we would argue that this is not a critical issue for our analysis considering that even in virtual hubs the gas physically passes through , albeit at a national level.

Importantly, the two price series seem to follow quite a similar pattern, which is consistent with the “common trend assumption” which the DiD strategy hinges upon.[22] The two price series seem to follow quite a similar pattern, which is consistent with the “common trend assumption” which the DiD strategy hinges upon[23] - see Figure 6.2 compares prices at the ZEE hub (in blue) to those in the TTF hub in the Netherlands (in orange).

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[18] One point of difference between the Belgian hub and the Dutch hub is that the ZEE hub is a physical hub (i.e. where the gas physically passes through the hub) while the TTF hub is a virtual hub (i.e. where gas enters only virtually after entering into a national system). However, this aspect does not pose too serious problems in terms of comparing both hubs, as even in virtual hubs the gas physically passes through , albeit at a national level.

[19] See CREG. 2006. ‘Study on the measures needed to improve the functioning and the liquidity of the Zeebrugge hub’. (F)060719-CREG-554.

[20] See para. 99 of the Commission decision (Case No COMP/M.4180 Gaz de France/Suez).

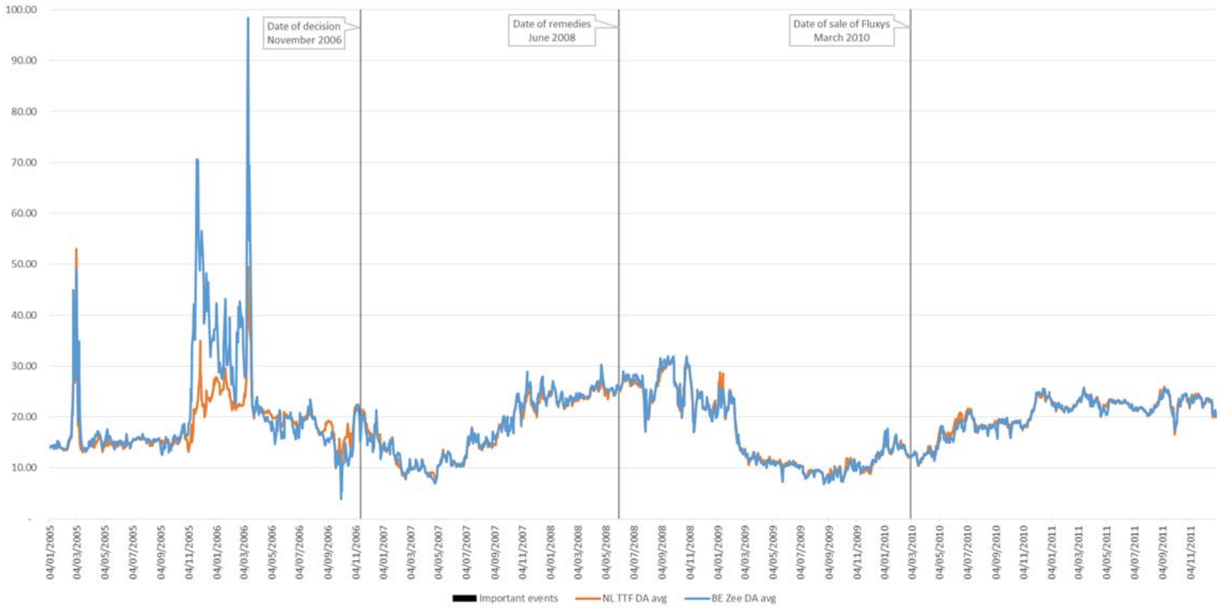
[21] The only alternative control hub would be the British hub, which however is not suitable due to the reason outlined in point 2, i.e. the high degree of interconnection with the Belgian hub.

[22] This assumption states that the treatment and control group would follow the same trend in the absence of the treatment.

[23] This assumption states that the treatment and control group would follow the same trend in the absence of the treatment.

There are some short-term price spikes in the ZEE hub at the end of 2005 / beginning of 2006, reflecting extreme external events. A brief cold snap took place in the UK for a short period of time at the end of 2005 coupled with a fire outbreak in the UK's main gas storage facility. The National Grid transmitted an emergency warning and this had an immediate effect on spot prices which experienced a period of exceptional spikes. Given the interconnectedness of the Belgian and UK hubs, this caused a spike in prices at the Zee hub as well[24].

Figure 6.2 Evolution of prices at the ZEE hub and at the TTF hub, 2006 - 2013



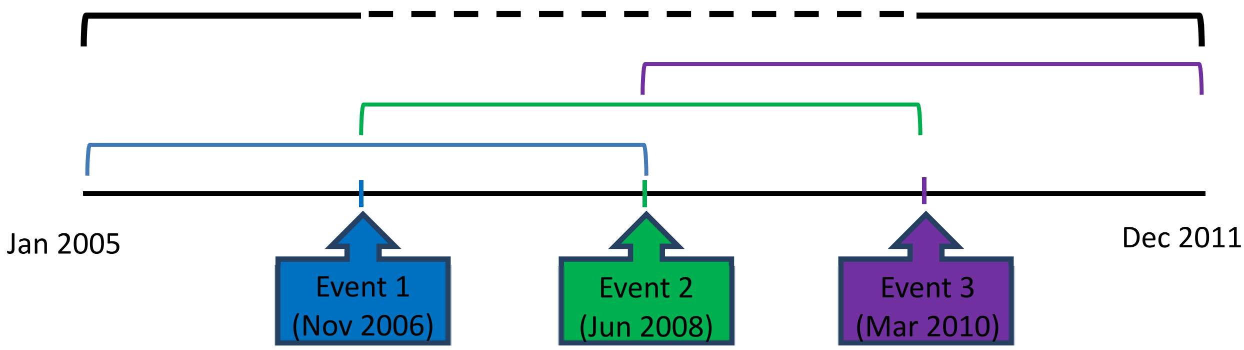
Source: Platts database. 2013.

6.4.2 The model

The main empirical model used was similar to the model used to estimate the effects of the E.On decision in the German wholesale market.

Our methodology aimed to quantify both the individual effect of each of these events, and their overall long-term effects.

Figure 6.3 Individual and overall effects of the events related to the merger



24 BBC News. 2006. 'Gas shortage sends prices soaring'. Available at: http://news.bbc.co.uk/1/hi/business/4802786.stm

Source: own figure

To quantify the impact of different events related to the merger decision, different definitions of the 'post' period were tested. Three dates most relevant to assess the overall effect of the merger were identified:

Event	Date of event	Time period over which effects are analysed
Event 1: The Commission's decision	November 2006	January 2005 (beginning of our sample period) and June 2008 (date of event 2)
Event 2: The effective divestitures of Distrigas and Fluxys and the consummation of the merger	June 2008	November 2006 (date of event 1) and March 2010 (date of event 3)
Event 3: GDF Suez sells its remaining stake in Fluxys to Publigas (+ some regulatory changes)	March 2010	June 2008 (date of event 2) until the end of 2011

6.4.3 Variables and data sources

We used the following *outcome variables* for the analysis: daily transaction price data for day-ahead wholesale natural gas traded during working days as published by Platts, both for the Belgian hub and for the Dutch hub. Our sample period ran from January 2005 until December 2011. For each working day (i.e., Monday to Friday), these data reflect the price range of a standardised quantity of natural gas to be delivered at a constant flow rate throughout the next working day after assessment (e.g., Friday's assessment reflects Monday's delivery).

The *regressors* were demand-side variables such as season and business cycles (*day, month* and *year),* as well as temperature (*temp*).[25]

Supply-side controls were prices indices of power prices as well as oil products, to which gas prices are typically related (*power, brent, coal*).[26]

6.4.4 Results

The results of the empirical analysis - presented in Table 6.3 - suggest that the Commission's decision and the implementation of the merger and its associated remedies impacted on wholesale gas prices in Belgium. Prices at the ZEE hub fell relatively to the TTF hub around November 2006 and June 2008, and to a lesser extent around March 2010.

The first event (i.e. the Commission's approval of the merger subject to conditions) may have had the largest strongest effect, although one needs to be slightly cautious in drawing implications from the magnitude of this coefficient (-2.364) because it might partly be due to the unusual price movements in the pre-merger period explained above.

However, a large coefficient for the merger approval might suggest an anticipatory effect. In particular, since the implementation of the remedies and the consummation of the merger took time, it is likely that at least some of the effects took place before the merger and remedy events were official. This would imply that the effect of the merger decision might partly incorporate the following events. In this regard, it is not surprising that the last event had small effect to, because it was largely anticipated by the market and therefore realized in advance.

[25] We also account for non-linearity in the effect of temperature by including a quadratic term in the regression.

[26] Coal prices may influence gas prices as coal and gas plants both are important electricity generators.

As a whole, the evidence suggests that **the remedies successfully limited the merger's potential anticompetitive effects, since the net effect of merger and remedies shows a price decline.**[27] Moreover, the estimated decline in prices, together with descriptive evidence of increased liquidity and traded volumes at the hub, supports **the view *that ownership unbundling improved access to the hub***[28]***.*** The remedies seem to have done more than simply mitigating the potential anticompetitive effects of the merger.

Table 6.3 GDF/Suez merger case: Impact of the Commission Decision on hub prices

	Event 1	Event 2	Event 3	Overall
Treat	2.593***	0.228***	-0.096	2.571***
	(0.576)	(0.061)	(0.058)	(0.572)
Post	1.339	0.255**	0.615***	9.236**
	(1.358)	(0.101)	(0.145)	(4.334)
Treat × post	**-2.364*** **	**-0.319*** **	**-0.105**	**-2.759*** **
	(0.586)	(0.083)	(0.074)	(0.577)
N	1,759	1,660	1,772	1,873

Source: DIW's analysis. The dependent variable is the daily gas price at the hub. In all specifications we control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Newey-West standard errors are reported in parentheses.

6.4.5 Caveats and limitations

The above results should be interpreted cautiously because the empirical analysis is subject to several caveats: (i) it is difficult to disentangle the effects of the events related to the merger and the divestitures; (ii) the selection of the control group is not perfect; and (iii) other relevant events (in particular regulatory changes) affecting the functioning of the wholesale gas market and hubs might contribute to our results.

27 It is not possible to disentangle the merger and the remedies, as they occurred around the same time. However, the net effect is informative of which effect dominated.

28 One cannot totally exclude that price declines in principle indicate that the merger has led to efficiency gains, which in turn have led to price declines thereafter. However, this is more unlikely, given that no potential efficiency gains at the hub were indicated by the merging parties.

7 Conclusions

7.1 Policy conclusions

7.1.1 Q1. Can one observe a change in the functioning of energy markets in the EU over the past two decades?

The structure of European gas and electricity markets has fundamentally altered during the last two decades. Most electricity and gas markets in Europe were national (vertically integrated) monopolies until the 1990s, when the EU and its Member States decided to gradually open them up to competition and establish a common energy market. Nowadays, in most Member States, there is a separation between regulated (transmission and distribution) and competitive segments (production and retail). Moreover, significant progress has been made towards energy market integration: many missing infrastructure links between EU countries have been built or are under construction; cross-border trade in gas and electricity between EU countries has increased; and wholesale prices are gradually converging.

Nevertheless, gas and electricity markets across Europe continue to exhibit certain characteristics that are potentially harmful to competition, most notably:

- Electricity and gas markets are still very concentrated in both wholesale and retail segments, creating scope for incumbents to exercise market power.
- While progress has been made in liberalising markets, the positon varies across Member States. Many Member States continue to regulate end-user prices and there is still insufficient separation of infrastructure and supply functions in energy markets.
- Public ownership of the first generation producer remains high in many Member States in both gas and electricity markets.
- Gas and electricity prices are increasing for consumers (except in 2014 when prices fell) and there are high levels of mark-ups in certain Member States
- There are significant price differentials for households across Member States, although energy prices for industrial consumers appear to be converging
- Switching levels are generally very low across Europe, with the exception of a few Member States.

Detailed investigations, beyond the scope of this study, are needed to measure any adverse effects on competition of the above features.

7.1.2 Q2. Can one observe a change in competition policy enforcement affecting energy markets in the EU over the past two decades?

There has been an increase in EU competition policy enforcement activity overtime and particularly since 2000 (when the first liberalisation directives were transposed in Member State legislation). Moreover, until 2003, merger cases in gas and electricity markets were more commonly handled under simplified procedures. Since 2003, a significantly higher share of the merger cases in gas and electricity markets have been subject to a full investigation, suggesting an increase in merger activity in these markets giving rise to competition concerns.

EU merger control has played a key role in improving market structure and functioning by limiting further horizontal and vertical integration in energy markets, which are already highly concentrated. In some cases, the remedies put in place to mitigate the potential anti-competitive effects of a merger have also contributed to promoting market liberalisation (e.g. EnBW/ EdF case in 2001). In extreme cases, the Commission has prohibited anti-competitive mergers (e.g. the proposed acquisition of joint control over GDP by EDP in 2001), although such cases are rare.

Anti-trust enforcement in gas and electricity markets has predominantly focused on tackling three issues: exclusionary conduct by dominant incumbents; exploitative abuses by dominant incumbents; and collusive behaviour.

Overall, energy markets have been subject to increasing competition enforcement action over time.

7.1.3 Q3. Has the enforcement of competition policy in the energy sectors contributed to better functioning energy markets? To what extent?

We compiled several pieces of evidence to provide a broad picture of the different channels through which competition policy enforcement affects the functioning of energy markets. Specifically, we analysed the impact of competition policy on measures of competition - the elasticity of profits with respect to costs (Boone's indicator) and productivity dispersion - and the effect of completion policy enforcement (through the competition channel) on outcomes such as investment and, ultimately, productivity. We also captured both direct and indirect effects of the policies i.e. both the impact of policy decisions on the firms involved, and on other firms in the same market, plus potential spill-overs and deterrents in other (national) markets.

EU merger control has had a robust positive and significant effect on the functioning of energy markets. Specifically, we found that the EU merger control has lowered both Boone's beta (elasticity of relative profits with respect to relative costs) and productivity dispersion, indicating that national energy sectors became more competitive following these interventions.

EU merger control is also related to higher investment and higher total factor productivity. This supports the reasoning that EU merger policy actions - through the channel of competition - may have encouraged energy firms to invest more, ultimately generating higher productivity. But, as mentioned earlier, caution should be applied in inferring causality; our results should be interpreted as providing strong correlations.

Impacts of antitrust enforcement and state aid control are much less clear cut. This does not necessarily imply that they were less effective. The result could reflect the limitations of empirical analysis: State aid and antitrust cases were fewer compared to merger cases, and it is possible that this prevented us from empirically identifying consistent relationships.

Although a single case study does not allow generalisations, the E.ON antitrust case does illustrate the positive impact of EU antitrust enforcement on German electricity markets. In this particular case, the Commission investigated E.ON's suspected abuse of its dominant position on the German wholesale market in 2008. There were concerns that E.ON may have withdrawn available generation capacity from the German wholesale electricity markets (to raise prices), and may have deterred new investors from entering the generation market.

The case resulted in substantial commitment by E.ON to divest 5000 MW of generation plants along with its extra-high voltage distribution network that structurally changed the German electricity market to the benefit of consumers. We empirically examined the impact of the Commission's Decision on wholesale electricity prices, using daily data on peak and off-peak prices from the EEX. The results show that the Commission's Decision, by affecting competition in the EEX, led to a reduction in wholesale electricity prices in Germany. To determine whether electricity suppliers eventually passed on wholesale price reductions to consumers we did an extended analysis of retail electricity prices using highly disaggregated data (monthly data at zip code level) purchased from the German price comparison website Verivox. The results suggest that the Commission's Decision - by reducing market power upstream and hence, reducing wholesale prices – might have also reduced prices downstream.

We also empirically evaluated the price effects of a merger case. The GDF/Suez merger finalised in July 2008, which aimed to create one of the world's largest energy companies, would have, as originally planned, weakened competition in the gas and electricity wholesale and retail markets in Belgium and in the gas markets in France, by quashing market competition between GDF and Suez. Our case study demonstrates that the remedies offered by GDF and Suez limited the potential anticompetitive effects of the merger (in Belgian wholesale gas markets which were the focus of study) and ownership unbundling, and might actually have improved access to the hub.

The broader econometric analysis, together with the two case studies, provides a consistent picture of positive impact of EU competition policy enforcement. Specifically, the two case studies show that commitments and remedies can be effective in addressing potential anticompetitive behaviour or effects and improve the functioning of markets.

7.1.4 Q4. Is there complementarity (in terms of objectives and effects) between competition and regulatory policies affecting the functioning of the energy markets? To what extent have we observed an increase in complementarity over the past two decades? Please explain

Regulation and competition policy can be complementary in several ways. The two can work together to support new entrants and smaller rivals in markets with an entrenched incumbent. Regulation is *ex-ante* and can provide certainty and facilitate market entry (by helping firms make forward-looking investment and production decisions). The facilitation of entry and promotion of effective rivalry creates the environment for more effective competition. The tools available to regulators and competition authorities could also generate complementarity. If extensive and/or frequent intervention is necessary, or where the remedies available to competition authorities are insufficient to address such conduct, regulation may be preferable. Competition law, on the other hand, typically has stronger powers to address anticompetitive behaviour.

It was not possible to carry out in-depth analysis of complementarities between competition policy and regulation within the scope of this study. Our broad econometric analysis (presented in section 4) examined the interplay between competition policy enforcement and regulation in energy markets. It shows that competition policy enforcement is more effective in liberalised markets as compared to markets that continue to be highly regulated. This supports the view that competition policy is mostly effective in markets where competition is not substituted by heavy regulation (as measured by the degree of entry regulation, public ownership, vertical integration and market structure).

There is however, the counter-argument that the impact of competition policy interventions can sometimes be stronger in highly regulated markets. For example, in countries where energy companies are vertically integrated or monopolised, anti-trust interventions to avoid market foreclosure and abuse of dominance can be important tools.

In practice, the Commission has been using instruments of competition policy enforcement together with regulation to promote reforms aimed at market liberalisation to improve the functioning of energy markets.

For instance, the Commission adopted the first liberalisation directives in 1996 (electricity) and 1998 (gas) to open up heavily regulated and monopolised national energy markets. A second round of liberalisation directives was agreed in 2003 and by 2007, all its provisions were in play.

Following the 2007 Sector Inquiry the Commission adopted the Third Energy Package to address some of the concerns highlighted in the Inquiry (e.g. insufficient unbundling and lack of cross border integration).

Repeated attempts at liberalisation, however, have had uneven success and competition has been slow to take off. The Commission has therefore been using the full range of competition policy tools at its disposal to improve the functioning of energy markets. For example, alongside regulation, the Commission has been using competition policy tools to promote unbundling and market liberalisation (e.g. GDF/Suez case, EdF/EnBW case).

7.1.5 Q5. Do competition case investigations and case decisions affect the design of sector regulations and the enforcement of such regulations?

Detailed qualitative research beyond the scope of this study is required to fully answer this question. However, it does provide some evidence. The GDF Suez merger is an example where a specific competition case affected the design of sector regulations and the enforcement of such regulations at a national level. In this particular case, the merger remedies led to ownership unbundling in the Belgian gas market. In addition, the Belgian regulator, CREG enforced, several regulatory changes to follow-up the merger remedies.

- The merger remedies were largely supported by the national regulator CREG, which was also involved in their implementation. This empowered CREG to push for more regulatory changes in the Belgian gas market as described above. In particular, the transfer of Fluxys and remaining assets underlying the physical structure of the Belgian gas market (such as transit, transmission, hub, LNG and storage) were essential to simplify access to the Belgian gas markets. Thus, merger remedies made regulatory changes on national level easier to implement.
- To further improve the functioning of its markets, it implemented a better congestion management of the network, reduced the number of balancing zones to one (instead of four) and introduced new rules of conduct.
- The part of the E.ON case not discussed (the balancing market) also sheds light on this because E.ON was forced to sell (unbundle) is balancing network.

At European level, the Third Energy Package was designed to address competition concerns identified by the 2007 Sector Inquiry. In this case, sector regulations were directly influenced by competition policy enforcement

7.2 Methodological reflections

We used different methodological tools to analyse the effectiveness of competition policy interventions in this study. This was necessary because of the wide array of questions the study was expected to answer. One the one hand, we were interested in analysing the broad impact of a large set of interventions—EU competition policy, national competition policy, and regulation--- and their interactions on a large number of firms active in different geographical markets (as energy markets are still to a large extent operating nationally). While such an analysis has the potential benefit of providing the 'big picture', it has the drawback that that many important details and specific questions cannot be cleanly answered due to the level of aggregation.

To tackle some of these detailed issues, we therefore, analysed single decisions through case studies. While case studies allow us to be more precise in modelling the peculiarities of relevant product and geographic markets and, hence, carry out a more detailed and granular analysis of the causal effects of specific competition policy enforcement decisions, the results of individual cases cannot be generalised.

Hence, the different methods proposed in this study should be seen as complementary and designed to answer related, but not entirely overlapping questions. A first important conclusion that can be derived from this study is that each research question or policy question requires a tailored method. Therefore, each particular result can be seen as a piece of the puzzle. A robust and credible evaluation exercise is one where several of these pieces can be put together in a coherent and convincing way.

While this study managed to stay close to this approach, the substantial issue of resource constraints needs to be noted. A large team of experts produced four separate empirical analyses, based on different data sources and empirical frameworks with a limited budget and within a rather tight timetable (less than 12 months). This inevitably imposed certain limitations on the depth and breadth of analysis that could be undertaken.

This study demonstrates that both, quantitative and qualitative approaches have their own limitations. Quantitative approaches require rich datasets that can be resource intensive to compile or expensive to acquire (e.g. firm level data from sources such as Amadeus/ Orbis database) . In some cases, the necessary data may not even be available. For example, in the GDF Suez merger case, we had to restrict the empirical analysis to only one part of the affected market due to non-availability of data. Moreover, data availability is a necessary but not sufficient condition to design a robust quantitative study. Quality, granularity and reliability of data are equally important considerations. For instance, in the E.ON case study, notwithstanding our efforts to collect a rich dataset for several European countries entailing information on wholesale prices and their drivers, this information was not good enough to create a reliable synthetic control group for the German wholesale markets. Hence, our identification strategy had to be adapted

In the broad econometric analysis, for instance, we put an enormous effort in collecting disaggregated, and comparable data on competition policy enforcement both at the EU and national levels. Given the limited variation in the data, however, we had to aggregate this rich information to be able to use it in an econometric exercise. This allowed us to generate findings which are more easily interpretable but, on the other hand, it did not allow us to fully identify channels through which policy enforcement affected outcomes. Moreover, limited variation in the data did not allow us to make clear inference on some dimensions of policy enforcement. The fact that we did not find statistically significant effect for some variables could, in our opinion, be due to the quality of the data—and thus not necessarily due to the absence of true effects.

Qualitative analysis can be helpful in filling gaps in data, enriching the quantitative results and in building a coherent framework. However, qualitative analysis cannot stand on its own as it does not establish causality; nor does it allow measurement of the precise effects of an intervention.

The ability to identify causal relationships is a key aspect of an evaluation study. Identification is the key methodological question of any econometric model. For a sound policy evaluation, it is crucial to be able to conclude that exactly that specific intervention was causing that specific outcome. Hence, it is vital to be able to exclude that other omitted factors were the explanation for the empirical findings.

In all chapters of this study, we put a serious effort to make our identification strategy as clean and as transparent as possible. In some cases, for example in the broad econometric analysis, it was unfortunately not possible to make strong causality claims. However, the findings can still be carefully interpreted as ‘controlled correlations’. Moreover, the focus on heterogeneous effects can help to further improve this interpretation. For instance, the fact that we observe competition policy enforcement to be more effective in countries that are less regulated is helping in attaching a causal interpretation to the results: competition policy cannot be particularly effective in markets where firms are not freely competing among each other, but are regulated by state intervention. However, especially because such analysis is expected to have significant policy implications, it is important to be transparent about the limitations and caveats of the analysis.

The issue of identification is also related to the level of aggregation and the quality of the data. The more ‘micro’ the level of analysis, the more likely it is that specific peculiarities of the case(s) or market(s) under consideration can be exploited to develop a clean identification strategy. Specifically in the two case studies, we were able to more cleanly identify causal effects by focusing on a difference-in-difference methodology tailored to the specificities of the case. The basic idea of this methodology, which is the most popular identification strategy in evaluation studies, is to look at the outcome of a group affected by an intervention and compare to the outcome of a control group. The variation over time in the outcome variable is then used to establish what would have occurred in the absence of the intervention. Such an approach is powerful and appropriate when looking at single decisions, but cannot be adopted to evaluate a large policy programme as there is not only one policy intervention (treatment) to be analysed and therefore, it is impossible to define a good counterfactual.

We believe that the last important step in a policy evaluation exercise is to provide evidence of the robustness of the provided inference. We carried out several robustness checks (e.g. placebo test) to provide additional empirical support for specific assumptions or to provide a broader picture— as in the econometric analysis where we look at different outcome variables to understand whether the effect of the policy was consistent along these different dimensions. All in all robustness checks, when leading to consistent results, are a strong instrument in assessing causal relationships and are a vital tool for policy evaluation.

The economic impact of enforcement of competition policies on the functioning of EU energy markets

European Commission, Directorate-General for Competition

Specific contract no. COMP/2014/003 implementing Framework Contract ECFIN-005-2011/LOT NO.1

A Report Submitted by ICF Consultancy Services in association with DIW Berlin

Technical Report

16 November 2015

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Abstract

This study examines whether EU competition policy enforcement has generated stronger competition in European gas and electricity markets and hence lower prices, higher investment and improved productivity. Specifically, the study analyses the impact of competition policy enforcement on short-run measures of intensity of competition such as relative profit elasticity and productivity dispersion (at sector-country level); and medium and long-term competitive outcomes such as investment and productivity (at firm-sector-country level). The main result of this analysis is that EU merger policy enforcement is consistently and significantly related to better market outcomes, especially in low-regulated markets. The impacts of the EU's anti-trust enforcement and state aid control on the other hand, are not statistically significant.

The study also empirically evaluates the price effects of two individual competition policy enforcement cases using the Difference-in-Differences (DiD) approach.

The first case study analyses the impact of the Commission's case against E.ON (2008) for its alleged abuse of dominant position in the German wholesale electricity market. Specifically, this case study examines the impact of the Commission's Decision on wholesale electricity prices, using daily data on peak and off-peak prices from the European Energy Exchange (EEX). The results show that the Commission's Decision, by affecting competition in the EEX, led to a reduction in wholesale electricity prices in Germany. To determine whether wholesale price reductions were eventually passed on to consumers by electricity suppliers, we further analysed retail electricity prices using highly disaggregated data (monthly data at zip code level) purchased from the German price comparison website Verivox. The results suggest that the Commission's Decision – by reducing market power upstream and thereby lowering wholesale prices – might have also contributed to reducing prices downstream.

The second case study examines the price effects of the Gaz de France (GDF)-Suez merger, approved by the European Commission in November 2006. The results show that the merger and associated remedies had a significant downward impact on wholesale gas prices at the Zeebrugge Hub in Belgium. This could suggest that the remedies were effective in limiting the potential anti-competitive effects of the merger.

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List of acronyms and abbreviations

ATE	Average Treatment Effect
BASF	Badische Anilin und Soda Fabrik
BBL	Balgzand Bacton Line
BDEW	Bundesverband der Energie- und Wasserwirtschaft e.V.
BKartA	Bundeskartellamt
CEER	Council of European Energy Regulators
CR1	One—firm concentration ratio
CR3	Three—firm concentration ratio
CRE	Commission de la Régulation de l'Énergie
CREG	Electricity and Gas Regulation Commission
DiD	Difference-In-Differences
ECS	Electrabel Customer Solutions
EDF	Électricité de France
EDP	Energias de Portugal
EEA	European Economic Area
EEX	European Energy Exchange
EIP	Energy-Intensive Plants
EnBW	Energie Baden-Württemberg
ENDESA	Empresa Nacional de Electricidad S.A
ENI	Ente Nazionale Idrocarburi
ENTSO-E	European Network of Transmission System Operators for Electricity
EnWG	Energiewirtschafts-gesetz
EPEX	European Power Exchange
ETCR	Energy, Transport and Communication
EWE	Energieversorgung Weser-Ems
FERC	Federal Energy Regulatory Commission
FYROM	Former Yugoslav Republic of Macedonia
GCC	Grid Control Cooperative
GDF	Gaz de France
GDP	Gross domestic product
GDP	Gás de Portugal
GMSL	Gas Management Services Limited
HHI	Herfindahl–Hirschman Index
ICE	Intercontinental Exchange
ICN	International Competition Network
IEA	International Energy Agency

IV	Instrumental Variable
LNG	Liquid Natural Gas
LTC	Low-Temperature Carbonization
MVV	Mannheimer Versorgungs- und Verkehrsgesellschaft mbH
NACE	Statistical Classification of Economic Activities in the European Community
NBP	National Balancing Point
NCA	National Competent Authority
NPS	Nord Pool Spot
OECD	Organisation for Economic Co-operation and Development
Ofgem	Office of Gas and Electricity Markets
OTC	Over the Counter
PPI	Producer Price Index
RCE	Relative Cost Efficiency
RPD	Relative Profit Difference
RSI	Residual Supply Index
RWE	Rheinisch-Westfälisches Elektrizitätswerk Aktiengesellschaft
SPE	Société Productrice d'Electricité (EDF Luminus)
SvK	Svenska Kraftnät
TAG	Trans-Austria Gas
TFEU	Treaty of the Functioning of the European Union
TFP	Total Factor Productivity
TSO	Transmission System Operator
TTF	Title Transfer Facility
VOLL	Value of Lost Load
ZEE	Zeebrugge Hub

1 Introduction

This study evaluates the impact of the EU's enforcement activities on the functioning of European gas and electricity markets. It is based on:

- A review of existing theoretical and empirical evidence of competition concerns in gas and electricity markets and the impact of competition policy enforcement on the functioning of these markets;
- A descriptive analysis of select indicators of market functioning such as levels of concentration and vertical integration, wholesale and retail prices, switching rates, etc.;
- A broad econometric analysis of the impact of competition policy enforcement on (i) short-run measures of intensity of competition such as relative profit elasticity and productivity dispersion, and (ii) medium and long-term competitive outcomes such as investment and productivity;
- Two case studies empirically analysing the price effects of specific Commission Decisions namely (i) the commitment decision addressed to E.ON for suspected abuse of a dominant position in the German wholesale electricity market[1] and (ii) the merger of Gaz de France (GDF) and the Suez group approved by the European Commission in November 2006[2].

Table 1.1 sets out specific evaluation questions addressed by the study and the methods, indicators and data sources used to build the evidence base behind these questions.

Table 1.1 Methodological approaches to answering the study questions

Evaluation questions	Methods	Indicators	Data sources
Q1. Can one observe a **change in the functioning of energy markets** in the EU over the past two decades?	Descriptive analysis Literature review	▪ Concentration indicators (HHI, CR3, number of players) ▪ Number of new entrants/ change in number of players ▪ Level of vertical integration ▪ Market liquidity ▪ Price and market regulation ▪ Public ownership ▪ Wholesale and retail prices ▪ Price mark-ups ▪ Switching rates ▪ Productivity dispersion ▪ Boone indicator	▪ Amadeus ▪ CEER ▪ Datamonitor ▪ DG ECFIN ▪ DG Energy ▪ ENTSO-E ▪ Eurostat ▪ IEA ▪ OECD ▪ Platts
Q2. Can one observe a **change in competition policy enforcement** affecting energy markets in the EU over the past two decades?	Descriptive analysis Literature review	▪ EU merger and anti-trust cases in electricity and gas markets	▪ DG Competition
Q3. Has the enforcement of competition policy in the energy sectors contributed to **better functioning energy markets**? To what extent?	Literature review Broad econometric analysis Case studies	Broad econometric analysis ▪ Productivity dispersion ▪ Boone indicator (elasticity of relative profits with respect to relative costs)	▪ Amadeus ▪ APEX/ENDEX ▪ Argus McCloskey ▪ CEER ▪ CREG

[1] Commission Decision of 26 X1 2008 available at: http://ec.europa.eu/competition/antitrust/cases/dec_docs/39388/39388_2796_3.pdf

[2] Press release: IP/06/1558 available at: http://europa.eu/rapid/press-release_IP-06-1558_en.htm

Evaluation questions	Methods	Indicators	Data sources
		▪ Investment ▪ Firm level productivity ▪ EU competition policy enforcement indicators ▪ National competition policy enforcement indicators ▪ Indicators of Product Market Regulation ▪ Other control variables (GDP per capita, population growth, energy imports, energy mix) <u>E.ON case study</u> ▪ Wholesale prices – German electricity markets ▪ Retail prices – German electricity markets ▪ Cross border electricity flows ▪ Oil prices ▪ Coal prices ▪ Gas prices ▪ Carbon prices ▪ Production of renewable energy <u>GDF/ Suez case study</u> ▪ Hub prices – ZEE hub and TTF ▪ Oil prices ▪ Coal prices ▪ Gas prices	▪ DG Competition ▪ DG Energy ▪ EEX/ EPEX ▪ ENTSO-E ▪ Fluxys ▪ National Power Exchanges ▪ OECD ▪ Platts ▪ Survey of NCAs ▪ US Energy Information Administration ▪ UX Company ▪ Verivox ▪ World Bank
Q4. Is there **complementarity (in terms of objectives and effects) between competition and regulatory policies** affecting the functioning of the energy markets? To what extent have we observed an increase in complementarity over the past two decades? Please explain	Literature review Econometric analysis Case studies	Same as above	Same as above
Q5. Do competition case investigations and case decisions affect the **design of sector regulations and the enforcement** of such regulations?	Literature review Case studies	Same as above	Same as above

NB: The ToR contained two <u>optional</u> evaluation questions: (i) How did the sector inquiry affect: (a) competition policy enforcement (in terms of competition case investigations and case decisions); and (b) regulatory reforms aimed at market opening and market access (including regulations on unbundling, infrastructure access, interconnections between national markets, and tariff setting)? (ii) What has been the added value of competition policy enforcement in the energy sector at the EU level as opposed to the national level (in terms of interconnections between national markets and in cross border trade)? These questions could not be addressed by the present study due to time and budget constraints.

The rest of the report describes the work in more detail, and presents the results of the study:

- Section 2 looks at the specific features of gas and electricity markets with the potential to restrict competition;
- Section 3 summarises existing theories and empirical evidence of the effect of competition policy interventions on the functioning and performance of energy markets;
- Section 4 provides a stylised overview of the current state of EU gas and electricity markets. It also briefly describes the Commission's competition policy interventions in these markets;
- Section 5 presents the results of an empirical analysis of the impact of EU and national competition policy enforcement on long-term market outcomes such as productivity and investment;
- Section 6 examines the price effects of the Commission's Decision in the alleged abuse of dominance by E.ON in German wholesale electricity markets;
- Section 7 evaluates the price effects of the GDF-Suez merger case;
- Section 8 addresses the five evaluation questions and sets out the policy and methodological conclusions of the study.

2 Specific characteristics of energy markets

Energy markets exhibit certain features that can prevent, restrict or distort competition, such as high entry costs, vertical market structure, and complex pricing mechanisms. Some of these require government intervention. For example, transmission and distribution networks are natural monopolies that need to be regulated. The resulting web of government policy and regulation has to be taken into account when examining the functioning of energy markets.

This section discusses the complex structural and policy characteristics of energy markets to put into context the analyses presented in the remainder of this report.

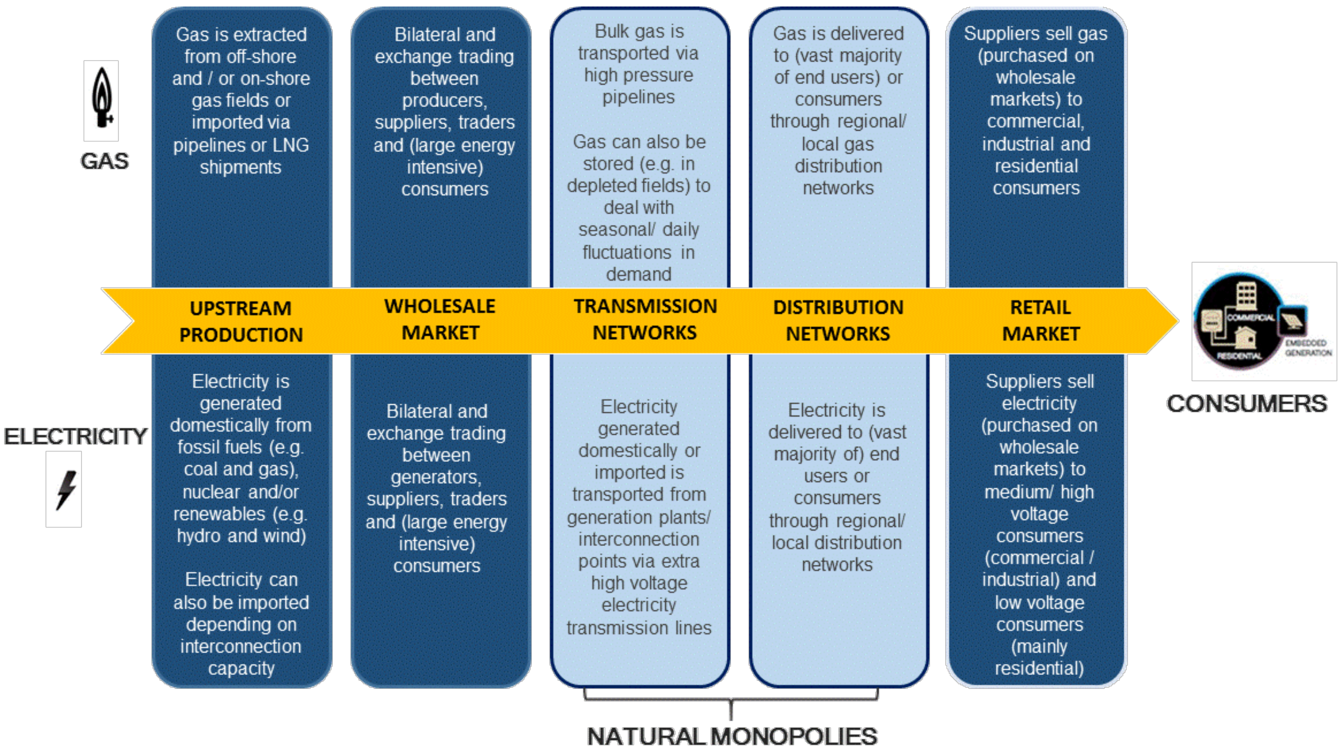
2.1 Structural characteristics

2.1.1 Complex supply chain

The energy supply chain consists of a number of segments with different characteristics (Figure 2.1). Energy transportation (transmission and distribution) is a naturally monopolistic and therefore, regulated activity, because of the infrastructure required (it would be expensive to duplicate gas pipelines or electricity grids).

Regulation determines the transportation costs passed on to consumers in their final energy bills (competition does not generally play a role in the setting of these prices). Production, wholesale and/or retail segments, on the other hand, are open to competition in liberalised energy markets. Wholesale and retail energy prices are therefore generally set by the interaction of demand and supply in fully liberalised markets, although some Member States (with partially liberalised markets) have retained regulated tariffs. The extent of price regulation in European energy markets is discussed in section 3.

Figure 2.1 The energy supply chain



Source: own figure

2.1.2 High entry costs

Another key characteristic of the energy supply chain is high entry costs i.e. the need for significant capital investment in infrastructure, particularly in power generation/gas production. As volatile wholesale prices do not easily support such large capital investment, energy producers tend to enter into long-term contracts with suppliers to ensure revenue certainty and stability. Policy intervention is often deemed necessary to support that investment and to avoid supply interruptions, although mechanisms for policy response vary across EU Member States and internationally (ranging from direct state investment in energy infrastructure, to market reforms and financial instruments aimed at securing private sector investment).

2.1.3 Vertical and horizontal integration

Economies of scale and scope in the supply chain often lead to vertical integration of energy generation/production with retail supply. Vertical integration also helps to support investment by providing a more reliable route to market for electricity generated. In Europe, liberalisation has led to universal separation of transportation networks. Nonetheless, many companies retain vertically integrated wholesale electricity generation or gas production and retail supply businesses.

The industry also has a considerable degree of horizontal integration, with energy suppliers supplying both electricity and gas and offering ‘dual-fuel’ deals, whereby customers get a discount by buying both fuels from the same supplier.

2.1.4 The need to balance supply and demand instantaneously

Unlike gas, electricity cannot be stored economically and needs to be consumed instantaneously. This means that supply and demand for electricity must be continuously matched or balanced to avoid black outs. In competitive electricity markets, there is generally a balancing mechanism. A Transmission System Operator (TSO) undertakes balancing actions i.e., identifies the need for, and procures adjustments in generation or demand to maintain balance in the electricity system.

TSOs can also use imbalance pricing arrangements to encourage market players to maximise their efforts to remain in balance (suppliers who use the networks are obliged to input the same amount of electricity as their customers take out, and are charged by the network operator for any imbalances). The TSO also maintains some generating reserves to ensure that the network remains in balance. The balancing mechanisms’ technical arrangements have important implications on competition and market prices, because procuring reserve capacities for system security and balancing energy normally entails commercial arrangements with imbalancing costs levied on the market through settlement mechanisms.

2.1.5 Complex pricing mechanisms

Wholesale prices: gas markets

In Europe, one can distinguish between **two main wholesale price formation mechanisms for natural gas: long-term contracts with oil-indexation and gas-on-gas competition**. Oil indexation is the traditional pricing mechanism with the price of gas pegged to the price of oil or oil products. Conventionally, oil-indexed gas is traded under long-term supply contracts (to provide security of supply to buyers and security of demand to producers). Under gas-on-gas competition, the price of gas is determined by the interplay of supply and demand, with trading taking place at physical hubs (e.g. Henry Hub) or notional hubs (e.g. NBP in the UK). Although oil indexation has historically been the dominant price formation mechanism in the EU, this changed in 2013. Gas on gas competition now represents 53 per cent of total consumption, displacing oil indexation as the dominant pricing mechanism[3]. However, these changes in wholesale gas price formation differ throughout Europe (Box 2.1).

Box 2.1 Wholesale gas price formation mechanisms in different parts of Europe

Northwest Europe (Belgium, Denmark, France, Germany, Ireland, Netherlands, UK) has seen the most dramatic change in price formation mechanisms, with a reversal from 72 per cent oil indexation and 27 per cent gas on gas competition in 2005 to 20 per cent oil indexation and 80 per cent gas on gas competition in 2013, as a result of increased hub trading and contract renegotiations, most notably in the Netherlands where gas on gas competition was 100 per cent in 2013.

In Central Europe (Austria, Czech Republic, Hungary, Poland, Slovakia, Switzerland) oil indexation declined from 85 per cent in 2005 to just below 35 per cent in 2013, while gas on gas competition increased from almost zero in 2005 to more than 50 per cent in 2013, reflecting increased imports of spot gas, often from Germany, with an element of contract renegotiation.

There has been much less change in other areas of Europe such as the Mediterranean (Greece, Italy, Portugal, Spain, Turkey), where oil indexation declined from 100 per cent in 2005 to around 85 per cent in 2013, and gas on gas competition rose from nothing to just more than 15 per cent, largely reflecting spot LNG imports with some spot pipeline imports into Italy, plus changes in the pricing of domestic production in Italy.

In Southeast Europe (Bosnia, Bulgaria, Croatia, FYROM, Romania, Serbia, Slovenia) there is still no gas on gas competition.

Source: International Gas Union, 2014, Wholesale Gas Price Survey, 2014 edition, A global review of price formation mechanisms 2005-2013.

Wholesale prices: electricity

In liberalised electricity markets, electricity is traded at power exchanges and bilaterally (Over the Counter [OTC]). Power exchanges have well-defined, standard power products, while OTC trade allows market participants to define contract details individually. OTC trade (typically, long-term contracts) may be supported by trade platforms other than exchanges, or by brokers, but can also be concluded bilaterally between parties without intermediates. In general, power exchanges have a spot market for physical delivery of the traded electricity on the following day (day ahead) for individual hours of the day, while intraday trade allows for very short-term deals for same day or next day delivery of base load or peak load blocks. Day-ahead prices are fixed in an auction for each hour of the following day, while intraday trade is continuous.

To set the price, power exchanges use the supply curve, called the ‘merit order curve’, that reflects the marginal costs[4] of the available generation technologies (nuclear, hydro, coal, gas, renewables, etc.). The co-existence of several generation technologies with different marginal costs, alongside other features of electricity markets (relatively inelastic demand coupled with daily/seasonal variations in demand) imply that generators with several generation plants may benefit from withdrawing some of their capacity from the market (where technically feasible) to increase prices and benefit their infra-marginal capacity (Federico, 2011).

Retail prices

Retail energy prices have three major price components, as illustrated in Figure 2.2:

- Energy costs: the wholesale element covers the costs incurred by companies to deliver the energy product on the grid (e.g. cost of production), while the retail element covers costs related to the sale of energy products to final consumers, including portfolio

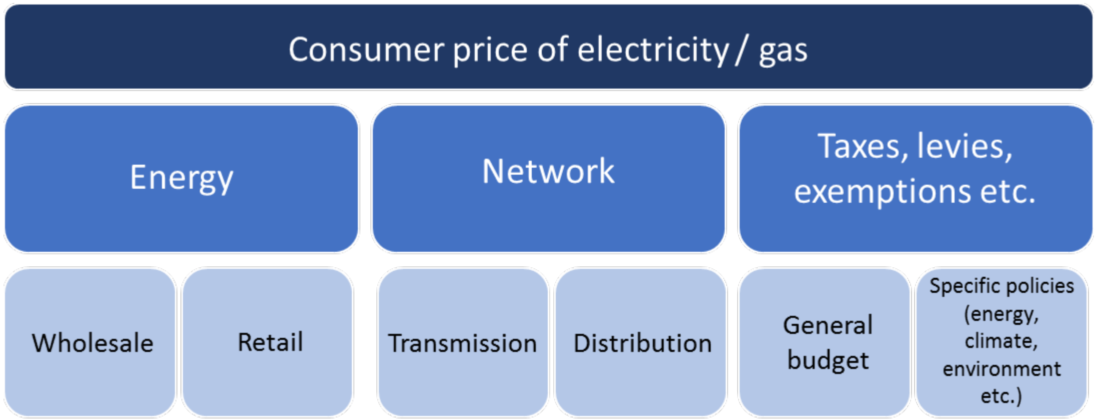
[3] International Gas Union, 2014, *Wholesale Gas Price Survey, 2014 edition, A global review of price formation mechanisms 2005-2013.* Accessed 26 September 2014 at http://www.igu.org/sites/default/files/node-page-field_file/IGU%20Wholesale%20Gas%20Price%20Survey%20Report%20-%202014%20Edition.pdf

[4] Marginal costs include fuel costs,CO_2 emission costs and other operational and maintenance costs

management (size and structure of client base), personnel, IT, overheads, insurance for imbalance, etc.;

- Network charges i.e. transmission and distribution costs;
- Taxes and other charges.

Figure 2.2 Components of electricity and gas prices



Source: COM(2014) 21 final - Energy prices and costs in Europe

The relative share of these components varies depending on the type of consumer (household or industry) and consumption band. Network charges, taxes, and other charges are regulated. The relative share of non-regulated price components (i.e. energy and supply costs) varies from 16 per cent in Denmark to 75 per cent in the UK[5].

2.2 Policy characteristics

Governments and regulators understand the need to minimise gas and electricity supply interruptions, both short and long term. Their policies for energy markets are generally threefold: security of supply, carbon emission reduction and affordability. However, these objectives often compete, for example climate change policies promote low-carbon technologies such as nuclear or renewables which are often more expensive than fossil fuel alternatives (thus conflicting the policy objective of affordable energy prices).

Government policy also affects the functioning of the market and the development of competition. For example, retail prices generally include a significant component attributable to taxes and levies. The levies tend to finance a mix of policies targeting energy sustainability or affordability. Between 2008 and 2012, this component grew faster in percentage terms across EU Member States than either the cost of energy or network costs, for both households and industrial customers.

Finally, some energy regulators have competing objectives. This can lead to regulatory policy that directly influences some indicators of market functioning, lowering their interpretive value. For example, product variety and customer choice are often seen as a positive indicator of developing competition. However, regulatory policy can affect or limit tariff choice, so influencing this particular indicator.

In the UK, the National Regulatory Authority (Ofgem) currently restricts the number of tariffs a retailer can offer household customers. In France, former incumbent monopoly suppliers EDF and GDF are required to offer customers a regulated retail tariff alongside competitive tariffs. Regulation can also indirectly influence the structure of both wholesale and retail markets, for example by affecting how easily new firms can enter those markets.

[5] Based on 2013 Eurostat data on electricity prices components for domestic consumers

3 Findings from the literature

There is only one prior study that has empirically evaluated the (ex-post) impacts of competition policy enforcement in gas and electricity markets. There is however, a wider pool of academic literature examining how mergers, ownership unbundling, long-term contracts or merger remedies affect competition in energy markets. Even so, only a handful of these studies provide an empirical analysis of competition issues in energy markets using econometric approaches. This section summarises the most significant and relevant findings from these studies.

3.1 Ex-post analysis of the impact of competition policy enforcement in gas and electricity markets

Pozzi (2004) conducted the only comprehensive empirical study of the (*ex-post*) effects of competition policy enforcement in energy markets is. He investigates the causes (or triggers) and effects of antitrust enforcement in US energy industries using a dataset of all federal cases (26 cases in total) representing the litigation activity of the US Department of Justice and the Federal Trade Commission in the oil, gas, coal and power sector from 1990 to 2004.

He uses a simple regression model to measure the *ex-post* effects of antitrust enforcement. Antitrust enforcement activity is modelled both as (i) the number of case per year (frequency) and (ii) the number of cases multiplied by a cardinal measure between one and four assigned to each case according to the gravity of the competitive restraint involved (intensity of enforcement activity). Dependent variables consist of HHI[6], price markups (measured as the spread of residential over industrial prices), industry profits, industry returns and HHI, markups and profits as a Granger cause[7].

The study finds some evidence of causality between antitrust enforcement and firm performance (industry markups and profits) in the electricity sector. And although antitrust enforcement appears to reduce downstream markups in the oil and gas sector, it has no impact on overall industry profits. Pozzi argues that downstream markups have little bearing on firms' operating profits in the oil and gas sector (according to the author, oil and gas firms mainly profit from crude oil prices and upstream operations).

3.2 Competition effects of mergers in the energy sector

Federico (2011) analyses in-depth the competition concerns raised by 10 significant mergers in the energy sector in Europe[8] and the remedies proposed by the authorities to mitigate their potential adverse effects on competition. Six of the eight European transactions studied raised horizontal concerns (which result from the loss of direct competition between players in a particular industry) in relevant wholesale energy markets (gas and/or electricity). Federico notes that horizontal effects were identified even when the combined market share of the merging parties was relatively low (examples include the 2008 EDF/British Energy merger case and the 2009 EDF/Segebel case), or where one of the parties was a small competitor to incumbent suppliers (e.g. the 2006 GDF/Suez case, analysed in this study), and even where loss of competition is potential as opposed to actual (e.g. the RWE/ Essent merger case, 2009).

Federico explains that horizontal effects are particularly prominent in the electricity generation sector, given the volatile demand of the market and the presence of several

6 HHI is used as a dependent variable only in the electricity sector

7 For oil and gas, the author uses markups and profits, as a Granger cause

8 These consist of the eight largest transactions assessed by the European Commission in the energy sector between 2004 and 2009 and two major gas-electricity mergers in Spain over the same period. The first was a proposed merger between the gas and electricity incumbents (Gas Natural and Endesa in 2005-2006) that eventually did not materialise for commercial reasons. The second was a smaller, but still significant merger between Gas Natural and Union Fenosa which was cleared by Spanish competition authorities in 2009.

generation technologies with different marginal costs. He predicts that these characteristics lend themselves to the risk of price spikes, which may benefit the merged entity.

At a retail level, horizontal effects were identified in five of the eight European transactions analysed by the author. These concerns predominantly related to actual or expected loss of competition for both residential and industrial consumers, due to greater convergence between gas and electricity retail offers.

He notes that the Commission also identified several 'non-horizontal' or vertical theories of harm in its assessment of mergers, warning these are inherently harder to evaluate and substantiate than horizontal effects. The main vertical effects raised by the eight European mergers are:

- *Input foreclosure due to lack of full ownership* unbundling of some network assets (e.g. electricity transmission, gas storage and transportation). If a merger brings together network assets that have not been unbundled with activities in the liberalised parts of the market (e.g. electricity generation; and gas and electricity retail), adverse non-horizontal effects may arise. In the presence of effective price regulation of the network inputs, these could take the form of quality-degradation of the network input to rivals of the merging parties. The integrated firm may face incentives to engage in such strategy precisely because it is price regulated, thus, undermining the standard argument that only 'one monopoly profit' can be obtained.
- *Input foreclosure of non-network inputs.* A vertical merger could potentially be an incentive for the merging party to increase the price of the input paid by competitors.
- *Customer foreclosure.* Vertical mergers may deprive upstream entrants from contestable downstream demand, raising entry barriers and discouraging new competitors.
- *Loss of market liquidity.* In energy mergers, there may be the danger that consolidation could result in the internationalisation of wholesale electricity trading between merging parties and significantly reduce market liquidity and thereby harm customers. Federico warns internalisation would not itself raise wholesale electricity prices, since an equal amount of power would be removed from the sales and purchases in the market (by definition). However, the theory of consumer harm is more indirect and relates to the greater price volatility that a reduction in liquidity may generate and the possible barriers to entry (either upstream and/or downstream) that may result.

According to Federico, the competition authorities overwhelmingly focused on analysing potential unilateral effects and no substantial analysis of the potential for coordinated effects was undertaken by the authorities concerned.

Unilateral effects

Although in theory there is a high potential for unilateral exercise of market power in electricity and gas markets, academic literature warns it can be extremely difficult to determine in practice. According to Leveque (2006), market power can be exercised in at least three different ways: by physical withdrawal of capacity that reduces a plant's output, by financial withdrawal, and by withdrawal of interconnection and storage capacity. He warns that anticompetitive behaviour is hard to detect because there can be valid reasons for capacity restrictions that push up prices (e.g., power failure or risk of equipment breakdown). He also argues that calculating the price-cost margin (key evidence for determining whether competition is being distorted) is complex because it requires distinguishing between different types of plants, factoring in variable costs on top of the cost of fuel, and considering the opportunity cost of not generating at a given time to be able to generate later (e.g., postponing the use of water from dams).

Several studies analyse unilateral exercise of market power in wholesale electricity markets. Some have identified strategic bidding and output decisions by individual firms (Borenstein and Bushnell (1999), Wolak (2000), Wolak (2003) and Wolfram (1998)), while s others have measured the departures of market outcomes from the competitive benchmark (Borenstein, Bushnell and Wolak (2002), Joskow and Kahn (2002) and Wolfram (1999)). Wolfram (1998), for example, analysed actual bidding behaviour in the daily electricity auction in the spot market in England and Wales 1992-94. Her findings suggest that generating companies strategically increase their bids to raise the price they are paid for infra-marginal capacity. Wolfram (1999) found that the size of mark-up was not as large as predicted by conventional oligopoly models. Her explanation is that the generators may be restraining prices either for deterring entry or for staving off substantial regulatory action.

Potential for coordinated effects

Electricity markets also contain features that facilitate the sustainability of collusion more than most other markets: daily trading organised as a uniform-price auction, firms are capacity constrained, demand is very inelastic in the short-term, and typically a small number of players protected by high entry barriers. Fabra and Toro (2004) analyse the time-series of prices in the Spanish electricity market and show t it is characterised by two significantly different price levels. They construct trigger variables that affect the likelihood of starting a price war. By interpreting the signs of the triggers, they can infer some of the properties of the collusive strategy that firms might have followed.

There is some empirical evidence to support the above theories of harm. For example, Fiorio and Florio (2009) show that vertical integration in the electricity sector leads to higher final consumer prices. Using a standard probit model, they conclude that consumers are less satisfied if firms are integrated. In line with earlier studies, their results for the gas industry differ substantially. Here, prices and vertical integration are uncorrelated and consumers are more satisfied with higher levels of integration. Similar studies dealing exclusively with the gas industry are Brau et al. (2010) and Growitsch and Stronzik (2009).

Newbery (2007) on the other hand argues that vertical mergers may be efficient. Wholesale markets create risks that are complementary for generators and suppliers, which could increase efficiency. If wholesale prices are high, generators' profits are high, but suppliers who have contracted to sell at fixed prices face rising costs and falling profits, and vice versa. These negatively correlated risks create a demand for, and supply of, hedging. But if contract markets are thin or illiquid, mergers (and, as discussed below, long-term contracts) between generation and supply are an attractive risk-reducing and hence synergistic strategy. Vertical integration also potentially reduces the cost of capital for firms, by reducing exposure to volatile market risk[9].

However, competition authorities argue that vertical integration can adversely affect competition in energy markets. Low levels of liquidity in the wholesale electricity markets act as a barrier to entry for non-integrated suppliers. They also block expansion for non-integrated suppliers already in the market. While vertical integration gives large suppliers guaranteed supplies of gas and/or electricity, it also reduces the availability of those products to smaller non-integrated suppliers

3.3 Competition effects of convergence mergers

As gas is an important input for electricity generation, wholesale natural gas and electricity markets are also vertically inter-related. Mergers between gas and electricity firms are sometimes called ''convergence'' mergers and are happening fast. (Hunger 2003). Several papers extensively analyse whether vertically related firms could benefit from foreclosing non-integrated rivals (see Rey and Tirole (2004) for a recent survey). Studies of vertical relationships in energy markets (e.g. Granitz and Klein (1996), Bushnell et al. (2005)) often explain their findings using this foreclosure argument. Rupérez-Micola et al. (2008) suggest higher prices are related to the existence of financial netback effects, or spark spread pricing, in energy markets, which prices wholesale natural gas against wholesale electricity prices, usually set with reference to retail tariffs.

Federico (2011) also documents concerns in several decisions regarding the integration of gas and electricity companies. Both input and customer foreclosure can be an issue. The vertically integrated merging party may face incentives to increase the price of the input (e.g. wholesale gas) to rival downstream supplier (e.g. electricity generation company), to benefit

9 Integrated suppliers are likely to have stronger credit ratings, allowing them to post lower levels of collateral. Without the benefit of this, non-integrated suppliers are required to post significant collateral to trade in wholesale markets (Ofgem, 2014)

its own downstream subsidiary. A vertical merger may also deprive upstream entrants from a source of contestable downstream demand, thus raising entry barriers and potentially discouraging entry in the first place.

Arguing against clearance of the Gas Natural/Endesa proposed merger, Barquin et al. (2006) claimed that a merger between electricity and gas incumbent companies would also instantly become dual fuel operators before any other existing or potential competitor has a chance to do so. Once a country is dominated by a national giant that integrates gas and electricity, it will be rare to find these champions engaging in cross-border competition. Instead, Padilla et al. (2005) claim that it is not necessary that, absent the merger, a foreign electricity company could buy gas from Gas Natural to generate electricity and then for Gas Natural would use that generation to offer dual fuel services. A foreign company could sell gas to Endesa to be used in its gas-fired plants and then cooperate with Endesa in the resell market to sell dual fuel offer services.

3.4 Impact of ownership unbundling

In contrast to the European Commission view, in academic literature there is not unambiguous support of the positive effects of ownership unbundling, neither in terms of consumers' welfare or prices, nor its effects on investment incentives.

In the theoretical literature, Bolle and Breitmoser (2006) argue that legal unbundling may be preferred to ownership unbundling because the negative effects of double marginalisation of ownership regulation outweigh the positive effects of more effective regulation. Cremer et al. (2006) also show that ownership unbundling is more detrimental to social welfare than legal unbundling because of the higher incentives for investments under legal unbundling.

Pollitt (2008) criticises Bolle and Breitmoser (2006) and Cremer et al. (2006) for their underlying assumptions. He reports that opposing results can be expected if more realistic assumptions are incorporated. For the former study he states that their model should take into account anti-competitive information advantages of legal unbundling for the rest of the integrated firm. In comparison, for the latter he does not consider the competition enhancing effect of ownership unbundling as well as the fact that double marginalisation assumes one-part tariffs, which is usually not the case for the electricity sector. Meyer (2012) offers a comprehensive survey on the effects of unbundling in the electricity sector.

Several studies cover the impact of different types of regulation or liberalisation. Steiner (2001) is one of the first authors to analyse the effects of the regulatory environment, the degree of vertical integration and the degree of private ownership on efficiency and end user prices. Efficiency is measured by capacity utilisation rate and reserve margin in electricity generation. Liberalising regulation, restructuring and private ownership are expected to lead to improved efficiency, and lower industrial electricity prices and industrial/residential price ratios. These hypotheses are tested for a panel dataset of 19 OECD countries for the period 1987-1996. There are controls for previous commitment to generation technology and the control for GDP serves as proxy for electricity market size. There are however, no controls for institutions or for macroeconomic policy. She finds that unbundling leads to increasing efficiency for the overall sector, however, the possible benefits are not necessarily passed on to private consumers via lower prices. However, no distinction between legal and ownership unbundling is made. Hattori and Tsutsui (2004) unlike Steiner (2001), find that unbundling appears to increase prices. Copenhagen Economics (2005) examines the level of market opening in several network industries by means of a dynamic panel data model. The study focuses on the EU-15 countries from 1993 to 2003 and concludes that higher levels of unbundling (with ownership unbundling as the highest form) leading to price reductions and increasing efficiency. Moreover, they conclude that unbundling the transmission grid is the most important element of market opening, but cannot say the same for gas sector.

In terms of investments, Alesina et al. (2005) analyse different regulatory reform processes in seven network industries in 21 OECD countries between 1975 and 1998. They show that regulatory reform of product markets has a positive effect on investments. Analysing the gas and electricity sector jointly, they conclude that investments increase with higher levels of unbundling. But they do not differentiate between ownership and legal unbundling.

Nardi (2010) disputes these findings. He analyses the impact of ownership unbundling on grid investments and quality. Although he finds higher grid investments in the network, he further shows that a substantial lack of quality emerges that confirms the resulting diseconomies of coordination when separating ownership and control of different company parts. According to Nardi, his results should be seen as first findings since only qualitative investment data is available and therefore no multivariate regression analysis can take place.

Gugler et al. (2013) provides an empirical analysis of the effects of ownership unbundling of the transmission grid as well as final consumer prices on investments and corroborate the inherent trade-offs present in large sunk-cost network industries. They estimate a dynamic panel regression models for the electricity industry in 16 European countries over the period 1998–2008, and find that ownership unbundling significantly reduces aggregate investment in the electricity industry. They also estimate an investment reducing effect of third party access to the electricity transmission grid. Moreover, there is a general trade-off between static and dynamic efficiency. Higher electricity end-user prices induce larger aggregate investments in the sector.

3.5 Long term contracts and competition in energy markets

Long-term contracts have become a priority for antitrust enforcement (and generate a lot of academic research). In the energy sector enquiry, the Commission stresses that integration between generation and retailing, including in the form of long-term supply contracts, creates a risk of foreclosure. The general argument–valid for both gas and electricity – is that vertical relationships reduce the liquidity of wholesale markets. Consequently, prices are more volatile and the signal quality sent to market actors is lower. This increases the risks for potential entrants into generation; they must either withdraw or invest both downstream and upstream. In the latter case, a vicious circle is created and the development of wholesale markets remains marginal. In the case of gas, entry barriers are even higher because of contracts that bind national historical importers and oil and gas majors for long periods. New entrants face both low liquidity in downstream wholesale markets and a shortage of gas available for import. The enquiry argues that it is difficult for a long-term supply contract not to lead to the elimination of competition on a substantial part of the products.

However, as argued by Hauteclocque and Glachant (2008), long-term contracts allow firms to hedge price and quantity risks and therefore facilitate asset-specific investments. Large and stable spot markets should be liquid enough to enable firms to sink high fixed costs investments based on reliable investment signals. Yet, European spot markets remain relatively under-developed, with inelastic demand and highly concentrated market structures. If spot markets are under-developed, future cash flows are uncertain and the uncertainty on the returns will lead risk-adverse investors to under-invest in generation capacities (Neuhoff and de Vries, 2004). Long-term contracts may mitigate this by providing an insurance device. Empirical research supports the theory and shows for instance that gas supply contracts linked to an asset specific investment are on average four years longer (Neuman and Hirschausen, 2006). In the opposite direction, as soon as asset specificity decreases, efficiency gains attached to long-term contracting decrease as well (Parsons, 1989; Doane and Spulber, 1994). This probably explains why where liberalisation has been implemented contract length naturally tend to decrease (Neuman and Hirschausen, 2005).

3.6 Remedies applied by authorities to mitigate competition concerns

Some of the most recent and important energy merger cases have been approved after parties proposed commitments to the Commission (e.g., between GDF and Suez, analysed in Section 7). Some of the antitrust cases, e.g., the E.ON case analysed in Section 6, have also involved commitments or remedies, both structural and behavioural.

In the energy market, structural remedies require the merging parties to divest part of their capacity and to open the market to new entrants and competitors interested in buying out the divested plants. Federico (2011) found that the European commission relied almost exclusively on structural divestments to address the competition concerns raised by the eight European mergers he examined. In his view, fairly demanding remedies were imposed by the Commission even in circumstances where the combined market shared of merging entities was relatively low. He concludes that particularly effective remedies are those that involve the sale of price-setting generation plants, network assets and merging entity's controlling stakes in existing competitors.

As argued by Verde (2008), structural remedies are irreversible and their success and effectiveness largely depend on the party to which the capacity is permanently divested. If the party is able to compete effectively, the additional capacity could reinforce its position and bring pro-competitive effects. Otherwise, negative effects prevail and the benefits in terms of lower concentration of the market are outweighed by the losses in terms of lower scale/scope economies.

Aside from structural remedies, competition authorities have also made use of behavioural remedies in energy markets. The latter broadly fall into two categories: virtual power plant (VPP) divestitures and gas release programmes (GRPs). The first one applies to the electricity market and the second to the gas market. In both cases, the company is not required to divest indefinitely its capacity, but only to release temporarily part of its production/capacity to its competitors, generally through devices such as auctions or bilateral agreements.

There is a vast body of academic grey literature examining the appropriateness of the remedies applied by the Commission in specific energy market cases. A particularly insightful and in-depth analysis has been carried out by Sadowska (2011), wherein the author critically notes that anti-trust cases are not being fully investigated to establish whether or not there has been a breach of competition rules; instead, the Commission only summarises its preliminary concerns regarding allegedly anti-competitive behaviour and specifies commitments agreed with the undertaking as a remedy to these concerns. On the basis of an in-depth legal analysis of two anti-trust cases[10], the author argues that competition policy was applied by the Commission beyond its proper limits in order to meet the objectives of sector-specific regulation in the electricity sector i.e. liberalisation and integration of energy markets. And while the commitment decisions might have contributed to achieving the policy objectives of the internal electricity market, but their use for that purpose might have negatively affected the electricity market either indirectly, by application of sector-specific regulation or competition policy building on previous commitment decisions, or directly, through the implementation of inappropriate commitments in individual cases.

3.7 Summary of key findings

The key findings from literature are:

Impact of competition policy enforcement on the functioning of energy markets. There is hardly any empirical literature on the *ex-post* effects of competition policy enforcement in energy markets. We only found one major study that empirically investigates the causes and (ex-post) effects of competition policy (antitrust) enforcement in US energy industries (Pozzi, 2004). In many respects, the broad econometric analysis and the case studies analysed later are new to the literature.

As regards the main results of Pozzi's work, he found little evidence to suggest that antitrust enforcement leads to a 'material and measurable' reduction in the exercise of market power.

[10] The first case concerns the alleged abuse of its dominant position by E.ON by withholding generation capacity in order to raise prices in the German wholesale electricity markets. The second case concerns the alleged abuse of dominant position by the Swedish network operator, Svenska Kraftnät (SvK). The network operator allegedly limited cross-border transmission capacity

Still, enforcement is found to have had some impact on firm profits: in electricity markets, profits decrease, whereas in the oil and gas industry there is no effect on firm profits, but downstream margins fall as a result of antitrust enforcement.

Impact of mergers on competition. Energy sector mergers can cause horizontal effects (loss of direct competition between merging firms) and non-horizontal effects such as input foreclosure due to lack of full ownership unbundling of some network assets (e.g. electricity transmission, gas storage and transportation); input foreclosure of non-network inputs; customer foreclosure; and loss of market liquidity.

Theoretically, vertical mergers (between generation and supply companies) could lead to efficiencies by providing a financial hedge against volatile wholesale energy prices and a natural hedge against balancing risk. Moreover, vertical integration could potentially reduce the cost of capital relative to similar non-integrated businesses, by reducing exposure to volatile market risk. On the flip side, vertical integration has the potential to adversely affect competition by reducing liquidity in wholesale markets. Moreover, empirical evidence shows that vertical integration leads to higher final consumer prices in electricity markets and lower levels of customer satisfaction. In gas markets, vertical integration did not to correlate with prices, but was associated with higher levels of customer satisfaction.

Impact of convergence mergers. The literature warns of the potential anti-competitive effects of convergence mergers (i.e. mergers between gas and electricity companies) such as input and customer foreclosure.

Impact of vertical linkages. Both vertical integration and vertical relationships between generation and supply (in the form of long term contracts) can act as a barrier to market entry or expansion by reducing liquidity in the wholesale markets. On the other hand, vertical linkages allow firms to hedge price and quantity risks, thus facilitating investment and contributing to long-term generation adequacy and fuel mix diversity.

Impact of ownership unbundling. The literature is inconclusive as regards the effects of ownership unbundling on end-user prices or on investment incentives. At a very basic level, unbundling can result in loss of economies that arise from vertical integration or linkages. On the other hand, empirical evidence shows that unbundling generally results in improved efficiency. However, academic literature provides contradictory evidence on whether these efficiency gains are passed on to consumers in the form of lower prices or not. Similarly, empirical evidence on impact of unbundling on investment is contradictory.

Design of remedies. Authorities have used both structural and behavioural remedies to address competition concerns arising from mergers or potential anti-competitive behavior. Structural remedies require the merging parties to divest part of their capacity and to open the market to new entrants and competitors interested in buying out the divested plants. Behavioural remedies mainly consist of virtual power plant (VPP) divestitures in electricity markets and gas release programmes (GRPs). Some academics have expressed concern that the Commission may have used competition policy tools to promote regulatory objectives i.e. liberalisation and integration of energy markets across Europe.

4 Descriptive analysis of the functioning of European gas and electricity markets

This section provides a descriptive analysis of select indicators of market characteristics and outcomes and an overview of EU competition policy enforcement activity in gas and electricity markets.

4.1 Conceptual framework for the descriptive analysis

The 2007 sector enquiry carried out by the European Commission highlighted several competition concerns with the functioning of European energy markets:

- High market concentration, particularly at wholesale level;
- Vertical foreclosure resulting from an insufficient level of unbundling between network operation on the one side and supply and/or generation activities on the other;
- Long contract duration and restrictive practices in relation to the operation of supply contracts, causing a lack of liquidity on wholesale markets and the foreclosure of downstream markets;
- Insufficient cross-border capacities blocking further market integration;
- Lack of efficient and transparent price formation and information asymmetry between incumbents and market entrants;
- Existing balancing regimes favouring incumbents and discouraging new market entrants.

More recently, the European Commission identified the combination of public ownership with high market shares, low cross-border interconnection and price regulation as a potential source of market malfunctioning.

It found that retail price regulation, particularly when prices were set below market prices rather than at wholesale market prices, contributed to market distortion by (i) strengthening the position of the historical incumbent; (ii) making it difficult for suppliers to recuperate their costs, thereby discouraging market entry; (iii) reducing incentives for firms to invest in and modernise infrastructure and services; (iv) damaging the competitiveness of European businesses by burdening them with higher energy costs[11]; (v) leading to over-consumption by consumers (European Commission, 2013). Additionally, low levels of switching - resulting in weak consumer pressure – are a concern in several national sector inquiries and market investigations (e.g. Germany, UK).

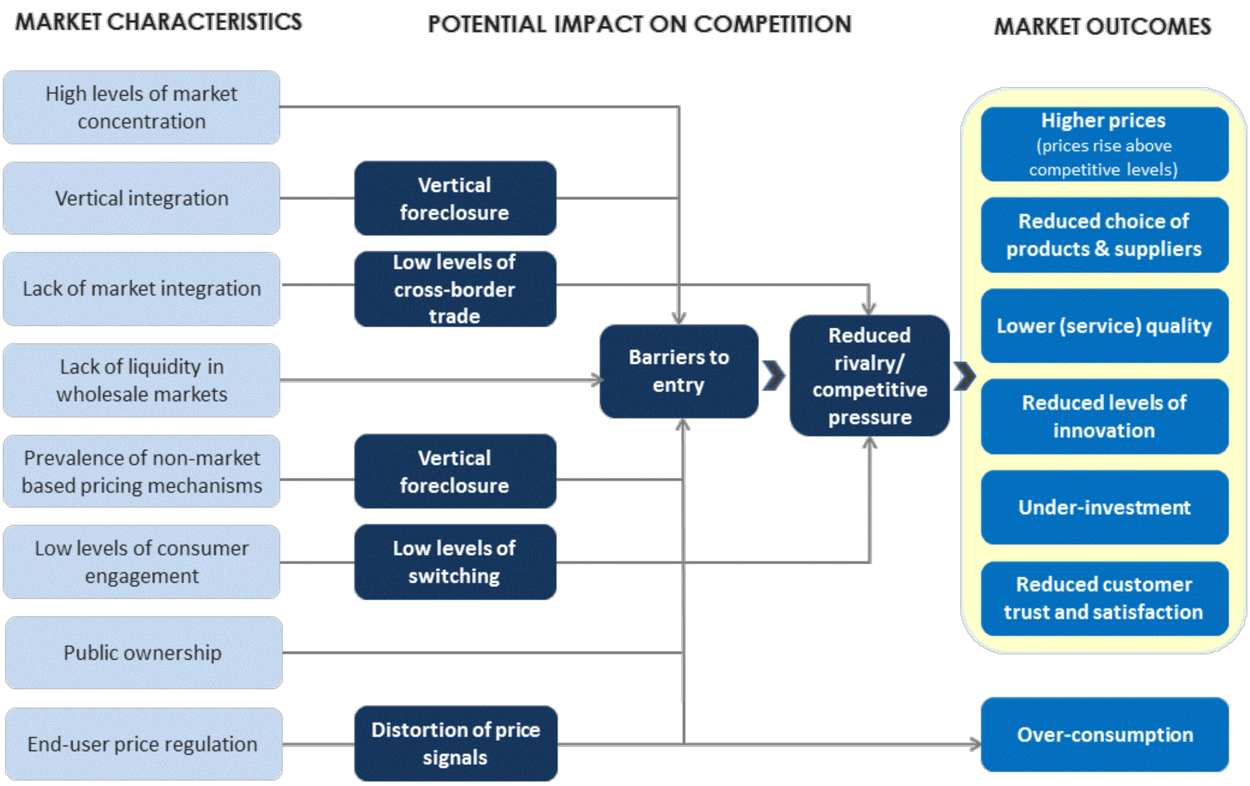
Economic theory and empirical evidence suggests that weak competition in energy markets can lead to detrimental market outcomes such as:

- reduced investment and innovation;
- high retail prices;
- reduced service quality to customers;
- less choice of products and suppliers; and
- low levels of customer trust and satisfaction.

Figure 4.1 illustrates the relationships between the market characteristics and outcomes described above.

[11] Electricity and gas suppliers tend to cross-subsidise loss-making segments (households) by setting higher prices for commercial customers (compared to the situation with no regulated prices).

Figure 4.1 Relationship between market characteristics and market outcomes



Source: own figure

While it is beyond our scope to assess in detail the functioning and performance of European gas and electricity markets, this section provides a high-level descriptive analysis of a selection of conventional indicators to identify key changes in market characteristics and outcomes that can be observed from the available data.

The overall framework for the descriptive analysis is summarised in Table 4.1. The list of indicators is not exhaustive. We focus on a limited number of indicators for which data is available for most EU Member States. Each provides a useful check on the state of the market. However, an adverse finding for a single indicator does not necessarily suggest a systemic problem in the way the market functions.

Table 4.1 **Framework for the descriptive analysis**
(P: Production/ generation, I: Infrastructure, W: Wholesale, R: Retail)

Indicator type		Indicator	P	I	W	R	What does this indicator tell us?
Market characteristics	High levels of concentration	CR3 - The share of the three largest companies (gas/electricity)	√			√	The market share of the three largest firms. This can give an indication of the extent of the largest firms' market power. Concentration ratios can show the extent of the market control of the three largest firms, and how far it may be oligopolistic.
		Number of players in a market			√	√	The absolute number of players/firms in a market.
		Herfindahl-Hirschman Index - HHI	√		√	√	A commonly accepted measure of market concentration, calculated by squaring the market share of each firm competing in a market, then summing the resulting numbers. The HHI can range from 0 (low concentration) to 10,000 (high concentration). The benefit of this indicator is that it includes the number and size of market participants.
	Barriers to entry	Vertical integration		√			The effects of vertical integration can be ambiguous. It can lead to greater efficiency that would not be achieved without integration, but may also cause the foreclosure of supply to non-integrated firms and higher barriers to entry. Vertical integration can raise barriers to entry or expansion, e.g., by limiting, or foreclosing, access to essential inputs or means of distribution to a non-integrated firm, or requiring any entrant to consider entering at both stages. An OECD indicator of vertical integration is used here.
		Number of new entrants/change in players			√	√	Changes in the number of market players can indicate market entry/exit. New market entry can act as a constraint, preventing firms from exercising market power.
	Levels of market integration	Interconnection capacity as % of total generation capacity		√			Insufficient interconnection capacity hinders cross-border trade. Lack of cross-border trade in turn reduces competitive pressure on domestic incumbents.
	Market liquidity	Trading volumes at hubs			√		Low wholesale market liquidity blocks access to wholesale energy at a competitive price.
	Regulation	Price regulation of households and non-household consumers.				√	End-user price regulation – particularly when these prices were set below market prices rather than at wholesale market prices – can distort the functioning of the market by (i) strengthening the position of the historical incumbent; (ii) making it difficult for suppliers to recuperate their costs thus discouraging market entry; (iii) reducing the incentives for firms to invest in and modernise infrastructure and services; (iv) damaging the competitiveness of European businesses by burdening them with higher energy costs ; (v) causing over-consumption.

Indicator type		Indicator	P	I	W	R	What does this indicator tell us?
		OECD Indicators of Product Market Regulation project, specifically the indicators of regulation in energy, transport and communication (ETCR)	√	√	√	√	A rating of the level of regulation within a market (on a scale of 1-6, 6 being highly regulated). The overall rating is based on a weighted approach considering four sub-indicators: entry regulation, public ownership, vertical integration and market structure. The values of the four sub-indicators for regulation of energy and gas markets are determined via the countries' answers to a set of questions. The degree of entry regulation depends on the answer to three (equally weighted) questions concerning i) third party grid access, ii) the existence of a liberalised wholesale market and iii) the ability of consumers to switch suppliers. The remaining sub-indicators are determined through one question each: public ownership is measured by the average share of government ownership in the largest firms in electricity (gas) generation, transmission, distribution and supply; vertical integration is measured via the legal requirements regarding unbundling (ownership separation, legal separation, accounting separation, no separation); finally, the market structure indicator is determined by the market share of the largest firm in the generation and supply sectors.
	Public ownership	Public ownership of first generation producer	√				Potential problems associated with public ownership not only include control issues, but potentially also preferential access to capital and distortions of competition both for and in the market, possibly exacerbated by regulatory capture.
Market outcomes	Price	Price trends / evolution: - Wholesale prices - Retail prices			√	√	Competition should in theory exert a downward pressure on prices. Thus, as markets become more competitive, prices are expected to fall. However, retail energy prices also include several components: wholesale energy costs; cost of transmission and distribution which are regulated and not affected by competition, and taxes and levies also unaffected by competition. Interpretations of raw price data should be cautious due to retail price regulation existing in some Member States.
	Mark-up	Mark up on wholesale prices				√	The level of mark-up on wholesale prices. Retail prices alone do not necessarily indicate the level of competition in a market – e.g.,, high retail prices may reflect higher input prices. These may include costs not determined by suppliers (such as network charges and taxes). Retail suppliers compete on the margin and this is

Indicator type		Indicator	P	I	W	R	What does this indicator tell us?
							the mark-up on their incurred costs. This indicates the level of competition (with lower mark-ups most commonly associated with higher levels of competition[12]).
	Switching	Switching rates				✓	The ability and willingness of consumers to switch in response to price signals is an important aspect of well-functioning markets. In competitive markets, we expect to see consumer actions, such as the threat of switching supplier, exert competitive pressure on suppliers. If switching is discouraged or impeded, it could deter new entrants from entering the market, assuming it will be difficult to persuade consumers to switch from their existing provider. This could potentially diminish the effectiveness of competition. However, switching data must be analysed with care and alongside other factors influencing the market. High switching levels do not automatically signify that a market is competitive. First, if pricing is unclear and products complex, price differentials and subsequently switching can occur over a long period of time, without the market becoming more competitive. Second, if suppliers' co-ordinate their behaviour to keep prices high, the market will not be competitive, regardless of switching levels. Third, high switching levels can conceal certain undesirable activities, such as misselling and churning.
	Intensity of competition	Productivity dispersion	✓		✓	✓	Competition increases productivity by forcing inefficient firms to exit and allowing efficient firms to enter. Competition also works as a stimulus by incentivising innovation and improving efficiency. Due to these competitive pressures, less productivity dispersion is expected in markets where there is high competition, high innovation and greater entry.
		Boone indicator	✓		✓	✓	This is an indicator of intensity of competition, punishing inefficient firms more severely in a competitive environment. The more negative the coefficient is, the more firms are punished for inefficiency Thus, more competitive environment with a greater policy push towards increasing competition is associated with a lower coefficient.

12 ACER. 2012. 'ACER Market Monitoring Report 2012'. Available at: http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Market%20Monitoring%20Report%202012.pdf

4.2 Functioning of the European electricity markets

The following discussion references the electricity markets dashboard (see Table 4.2), with relevant time trends detailed in the Annex (see A2.1).

4.2.1 Market shares and concentration

High market concentration can be problematic as it creates the scope for dominant firms to exercise market power. The 2007 Sector Inquiry highlights that generators can influence prices in two ways: either by withdrawing capacity from the market, or by increasing prices when their production is required to meet demand. Since the Sector Inquiry, market concentration in electricity generation – as measured by the Herfindahl-Hirschman Index (HHI) - has fallen in almost all Member States except Germany and Hungary (which have seen very small increase in the index of 82 and 320 respectively). The most significant decreases occurred in Greece (a change of 3,613), Belgium (2,614), Estonia (1,928) and Lithuania (1,761).

Wholesale markets in several Member States, however, remain highly concentrated and continue to be dominated by former monopoly generators. Market shares of above 20 per cent for the largest generator can cause concern. In 16 Member States, the market share of the largest generator exceeds 20 per cent and in 18 Member States, the value of the HHI measure exceeds the commonly accepted threshold for highly concentrated markets (HHI= 2,000). Moreover, the small island nations of Cyprus and Malta continue to be monopolised, with 100 per cent of their electricity generated by the largest (sole) generator. Member States such as Germany, Finland, Italy and the Netherlands, on the other hand, exhibit relatively low levels of market concentration.

Retail electricity markets show similar patterns of concentration (with an average HHI of almost 4,500 and CR3[13] of 74 per cent across the EU). In 14 Member States, the market share of the three largest suppliers exceeds 60 per cent, indicating high levels of concentration. Incumbents have been able to maintain their market shares, with too few new entrants (European Parliament, 2010).

On the positive side, market concentration, in general, has decreased during the last decade (on average the CR3 indicator has decreased by 5 per cent at an EU level between 2007 and 2013). But a mixed picture emerges at a national level, for example in Bulgaria and Lithuania, the CR3 indicator almost halved between 2007 and 2003, whereas in Poland and Slovakia, the CR3 ratio increased significantly in recent years.

4.2.2 Vertical integration

While vertical integration can bring benefits to electricity suppliers (enables efficiency and offers security against volatility in the wholesale market, as discussed in Section 3) and consumers (generating lower prices), there are potential downsides. For instance, vertical integration can discourage independent, non-vertically integrated firms from entering the market by reducing liquidity in the wholesale electricity markets.

Vertical integration guarantees wholesale electricity products to large suppliers, thus reducing their availability to smaller non-integrated suppliers (Ofgem, 2014). Vertically integrated firms may use their position to undermine competition from independent generators by their unwillingness to sign long-term offtake contracts with them, unwillingness to trade certain products or to trade with independent generators, or dispatching their own generation even when cheaper generation is available from other firms (customer foreclosure). They may also disadvantage independent retailers through input foreclosure: if a firm has any market power in generation, it can increase wholesale electricity prices by generating less at a given price, increasing input costs for independent suppliers. A vertically

[13] Market share of the largest three suppliers. Ideally, the top three suppliers should have a combined market shares of less than 60 per cent

integrated firm can also restrict trading or otherwise worsen liquidity, either increasing traded prices or imposing a risk premium on independent suppliers (Ofgem, 2015).

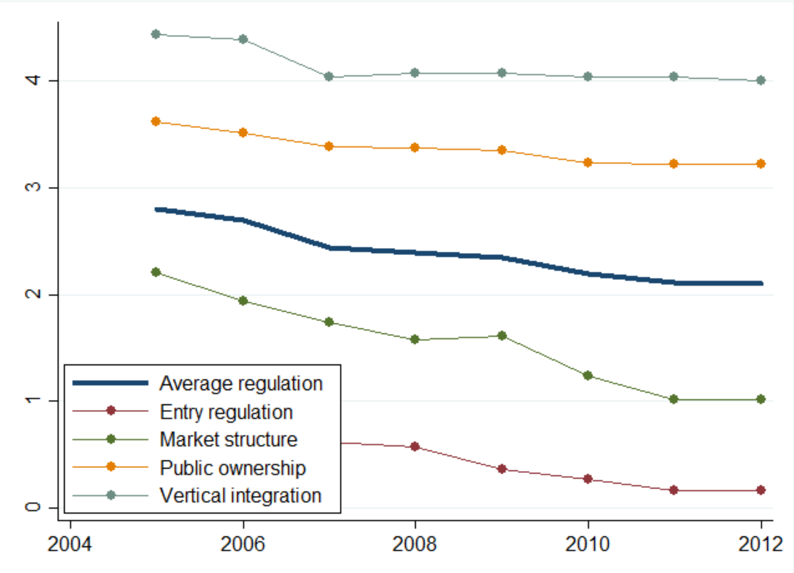
Available data shows that, although the level of vertical integration has on average decreased since 2007, it remains reasonably high throughout Europe (as measured by the OECD vertical integration indicator[14]). There are some differences across Member States. For example, Bulgaria had the highest level of vertical integration in 2013 with an index value of 5.25, followed by France, Germany and the UK with an index value of 4.69. Lowest levels were observed in Portugal (2.45), Belgium (3.00) and Ireland (3.00).

4.2.3 Regulation

The OECD indicators of Product Market Regulation show the overall level of regulation in electricity markets across Europe. The indicator is composed of four sub-indicators measuring the degree of public ownership, entry regulation, vertical integration and market structure. As expected, regulatory environment in electricity markets varies across Europe, with Germany, Portugal, Spain and the UK operating a less regulated market compared to Cyprus, Croatia, Latvia and Malta, which are highly regulated. As part of the broader econometric analysis, we examine the interplay between competition policy enforcement and regulation by distinguishing between effects in high and low regulated markets.

Figure 4.2 shows the average rates of regulation across Member States over time. The entry regulation and market structure indicators begin relatively low and gradually decline between 2004 and 2012. The indicators for public ownership and vertical integration begin relatively higher and only decline slightly.

Figure 4.2 Average rates of regulation across EU Member States in electricity markets, 2004-2012



Based on DIW's analysis of OECD data

Drilling down further, price regulation in the household segment of the market exists in more than half of the Member States. For industrial consumers, regulated prices exist in 11 of the 28 Member States. Price regulation, particularly when these prices are set below market prices and not in line with wholesale market prices distort the functioning of the market by (i)

[14] The value of the OECD vertical integration indicator ranges from1-6. It is based on a simple average of the degree of vertical integration over the four segments of the market: generation/import, transmission, distribution and supply. Rating scale is as follows: a 0 is ownership separation, 3: legal separation, 4-5: accounting separation, 6: no separation

strengthening the position of the historical incumbent; (ii) discouraging market entry by making it difficult for suppliers to recuperate their costs; (iii) reducing incentives for firms to invest in and modernise infrastructure and services; (iv) damaging the competitiveness of European businesses by burdening them with higher energy costs; (v) leading to over-consumption by consumers (European Commission, 2014).

Regulated prices also discourage switching by being a focal point for alternative offers that cluster around the regulated offers. This then undermines incentives to enter the market, competition between suppliers and quality of services (ACER, Market Monitoring Report 2014).

We also looked at the specific issue of ownership unbundling in electricity markets. The Third Energy Package proposed in 2009, which applies to both electricity and gas, requires an effective separation of the transmission networks´ operation from supply and generation activities (unbundling). In the transmission segment, there are several ways to unbundle: (i) separation of accounts and an independent operator (ITO, Independent Transmission Operator); (ii) operational separation where a company can operate the network without owning the network (ISO, Independent System Operator); and (iii) full divestiture of both entities (ownership unbundling). The latter is widely accepted as the optimal model because it eliminates any incentives to discriminate. According to the latest information (2013), 15 Member States have chosen to apply the ownership unbundling model on at least one Transmission System Operator (TSO) in electricity.

4.2.4 Market integration

Belgium, Hungary, the Netherlands and the UK have a high proportion (between 50 and 90 per cent) of the supplier market share represented by cross-border entrants. The average market share of cross-border entrants across the EU is much lower at 21 per cent. Although trend data is not available for this indicator, evidence from other sources suggests an increase in cross-border market entry in the energy sector in recent years. For example, Verde (2008) examined recent merger activity within the European energy sector and observed a clear trend towards the creation of pan-European players through cross-border merger and acquisition activity.

The proportion of cross-border trade to total domestic electricity consumption can also show the extent a country engages in cross-border trade. Higher proportions of cross-border trade to domestic consumption may indicate greater capability for cross-border trade (due to infrastructure) but can also be part of a country’s capacity to meet its own demand domestically. The Czech Republic, Estonia, Slovenia and Latvia show a greater share of outflows to domestic consumption.

4.2.5 Public ownership

Competition problems associated with public ownership include control issues, preferential access to capital and distortions of competition both for and in the market which can be exacerbated by regulatory capture.

The latest available data (2010) on public ownership of the first generation producer compiled by the European Commission (DG ECFIN, 2014) shows that high levels of public ownership of the first generation producer (> 50 per cent) still exist in the electricity sector.

The average across all Member States stands at 61.6 per cent, with 95-100 per cent public ownership in 11 Member States. 100 per cent ownership exists in Bulgaria, Cyprus, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Slovenia and Sweden. Many of these countries are more recent accession countries (with the exception of Sweden), and may have been pursuing market liberalisation policies for less time. In contrast, Belgium, Germany, Portugal, Spain and the UK have completely divested the previously State-owned assets of the first generation producers.

4.2.6 Prices

Although there is evidence of wholesale price convergence across national markets in recent years (2008 to 2013), price differentials remain significant. In 2013, Romania had the lowest average wholesale baseload electricity prices (38.59 €/ MWh), with Italy the highest (74.21 €/MWh), resulting in a price differential ratio of 1.9 between the cheapest and the most expensive country in the EU.

Prices in Italy, Ireland and the UK were among the highest in the EU in 2013, either because of the lack of sufficient interconnection capacities to neighbouring power markets (Italy and Ireland), or because expensive generation fuels dominated the marginal price in the wholesale market (natural gas in the case of the UK) (European Commission, Quarterly Report on Electricity Markets, Q4-2014).

The average retail electricity price for households has increased from €0.14/KWh to €0.18/KWh between 2007 and 2014, with an average year-on-year change of 5 per cent[15]. For industrial customers, prices have increased slightly less from €0.09/KWh to €0.11/KWh during the same period and similarly had an average year-on-year change of five per cent[16]. Both are much higher than the average inflation rate of 2.12 per cent for the EU during the same period.

Huge price differentials remain across Member States within retail electricity prices for households, although retail electricity prices for industrial consumers appear to be gradually converging:

- For households, prices range from €0.09/KWh in Belgium to €0.30/KWh in Denmark and Germany, causing a price differential of 3.5. The lack of convergence could be due to the increasing importance of non-market elements (such as network costs, taxes and policy levies) within the final retail prices, or other structural issues such as competition or the presence of end-price regulation.
- For industrial consumers, prices range from €0.07/KWh in Finland and Sweden to €0.19/KWh in Malta, causing a price differential of 2.7. The smaller price differential could be because industrial consumers are subject to less retail price regulation compared to the household sector and the better negotiating position of industrial consumers, leading to better competition among power utilities.

The mark-up on wholesale prices (i.e., the difference between wholesale prices and the energy component of the retail price) can show the level of competition in the electricity market (with persistently high mark-ups associated with low levels of competition). The average electricity price mark-up across the EU has increased from €11.17/ MWh in 2008 to € 14.12/ MWh to 2013.

Electricity price mark-ups are highest in Greece, the UK and Germany and negative in some Member States (the Czech Republic, Lithuania, and Romania). Mark-up differences can be explained by cross-country differences in operating costs of suppliers, volatility in wholesale prices, market size and consumption level .In Lithuania and Romania, mark-ups are negative due to the existence of regulated prices (in these countries retail energy price component seems to have been set below wholesale energy prices). In the Czech Republic and Spain, negative mark-ups could be due to significant entry/exit activity (CEER/ACER, 2014 Market Monitoring Report).

4.2.7 Switching

The ability and willingness of consumers to switch in response to price signals is important to well-functioning markets. In competitive markets, consumer actions, such as the threat of switching supplier, exert competitive pressure on suppliers. If switching is discouraged, it can deter new entrants from entering the market, believing it will be difficult to persuade

15 Consumption band DC for households (2,500 KWh < consumption < 5,000 KWh)

16 Consumption band IC for industrial customers (500 MWh < consumption < 2,000 MWh)

consumers to switch from their existing provider, potentially diminishing the effectiveness of competition.

Data on switching rates in electricity markets is patchy, making it difficult to draw any conclusions. Available data shows that electricity switching rates are low in several Member States (< 10 per cent) except for Portugal, the Netherlands, Spain and the UK which have relatively high levels of switching (ranging from 13 to 26 per cent).

A low switching rate in itself is not indicative of market mal-functioning, but other qualitative evidence suggests that there might be barriers to switching in energy markets (CEER/ACER, 2014 Market Monitoring Report). Low switching rates support the conclusion that the actual level of competitive pressures arising from consumers in electricity markets may be limited.

Table 4.2 European electricity markets – stylised overview

	Market characteristics												Market outcomes			
	Electricity generation				Infrastructure				Retail markets							
	Market share of the largest operator (%)	Market share of 3 largest generators (by volume, %)	HHI power generation	Public ownership of first generation producer	Vertical integration (1: no vertical integration; 6: high levels)	Effective unbundling	Market share of cross-border entrants	Av. wholesale baseload electricity prices (€/MWh)	HHI in electricity retail market	Market share of 3 largest retailers (by volume, %)	Price regulation - Households	Price regulation - non-households	Mark-up - wholesale to retail electricity prices (EUR/MWh)	Retail price: Households (Euro / KWh)	Retail price: Industry (Euro / KWh)	Switching rate (%)
Year:	2012	2013	2013	2010	2013	2013	2013	2013	2013	2013	2014	2013	2013	2014	2014	*2013*
t range:	2000 - 2012	2004 - 2013	2005 - 2013	2010 only	2000 - 2013	2010 & 2013 only	2013 only	2008 - 2013	2011 & 2013 only	2004 - 2013	2013 only	2008 - 2013	2008 - 2013	2007 - 2014	2007 - 2014	*2013, 2008-2012 av*
Source:	Eurostat	CEER	Platts	DG ECFIN	OECD*	DG ECFIN	ACER	CEER	DG ENER	CEER	DG ENER	CEER	CEER	Eurostat	Eurostat	*CEER*
AT	56.60	50.1	1792.7	51.0	3.9375	ITO/OU	n.a.	52.08	1800	57	NO	NO	23.72	0.20	0.11	1.80
BE	65.80	92.0	3783.2	0.0	3	OU	91.47	48.70	3000	n.a.	NO	YES	22.20	0.21	0.11	14.60
BG	n.a.	49.0	2650.0	100.0	5.25	ITO	33.68	n.a.	n.a.	49	YES	YES	n.a.	0.09	0.08	0.00
CY	n.a.	100.0	9556.4	100.0	n.a.	n.a.	n.a.	n.a.	10000	100	YES	YES	n.a.	0.23	0.18	0.00
HR	82.00	95.8	8728.6	n.a.	3.5625	n.a.	n.a.	n.a.	4516	97.81	YES	n.a.	n.a.	0.13	0.09	0.00
CZ	68.00	77.1	4046.9	70.0	4.6875	OU	17.68	50.62	n.a.	70	NO	NO	-6.42	0.13	0.08	5.70
DK	37.00	65**	2240.4	76.0	4.125	OU	n.a.	41.03	n.a.	n.a.	partly	YES	7.27	0.30	0.09	6.20
EE	88.00	92.0	7200.0	100.0	3.1875	OU	n.a.	44.80	6869	99	YES	NO	3.10	0.13	0.09	0.00
FI	25.20	n.a.	1164.2	51.0	3.9375	n.a.	15.84	45.55	n.a.	40	NO	NO	14.75	0.16	0.07	7.50
FR	86.00	98.0	6453.1	84.0	4.6875	ITO	6.85	54.10	4500	84	YES	YES	3.30	0.17	0.09	2.00
DE	28.4*	56.0	1274.0	0.0	4.6875	OU/ITO	4.65	50.70	n.a.	n.a.	NO	NO	35.90	0.30	0.16	5.70
EL	77.00	90.2	4328.7	100.0	4.5	ITO	n.a.	44.00	9604	99.72	NO	YES	48.80	0.18	0.13	0.10
HU	47.10	55.1	2150.4	100.0	4.125	ITO	80.30	57.37	1584.38	86.42	YES	YES	0.23	0.12	0.09	0.00
IE	55.00	79.0	2540.8	95.0	3	Other	22.80	70.60	4759	83.3	NO	NO	25.48	0.25	0.13	11.30
IT	26.00	39.9	1527.9	31.2	3.9375	OU	6.92	74.21	1865	46.2	NO	NO	10.83	0.24	0.17	7.60
LV	89.00	83.0	9097.2	100.0	3.9375	ISO	n.a.	55.27	8196	99	YES	NO	0.53	0.13	0.12	0.00
LT	30.40	65.0	5342.7	100.0	3.375	OU	n.a.	51.01	2124.4	53	YES	NO	-2.96	0.13	0.12	0.00
LU	81.80	73.9	5185.1	25.0	4.6875	n.a.	13.10	49.96	n.a.	96	NO	NO	19.84	0.17	0.10	0.10
MT	100.00	100.0	9310.2	100.0	4.5	n.a.	n.a.	n.a.	10000	100	YES	YES	n.a.	0.14	0.19	0.00
NL	n.a.	53*	1225.1	0.0	4.5	OU	49.30	55.82	2338	80.5	NO	NO	20.38	0.18	0.10	13.10
PL	16.40	62.6	1698.9	62.0	4.6875	OU	5.10	47.88	2099	67.36	YES	NO	10.72	0.14	0.08	1.00
PT	37.20	59.5	3847.7	4.0	2.4375	OU	25.60	52.17	6918	85.5	NO	YES	14.56	0.22	0.12	26.80
RO	26.70	66.1	1480.7	80.0	3.375	ISO	40.80	38.59	1472	58	YES	YES	-1.99	0.13	0.08	0.00
SK	78.90	56.4	5900.2	34.0	4.3125	OU	33.20	39.60	n.a.	64.55	YES	YES	23.70	0.15	0.12	3.60
SI	55.20	90.0	5391.7	100.0	3.75	ITO	n.a.	47.04	1575	57.1	NO	NO	14.16	0.16	0.09	3.90
ES	23.80	58.1	1522.6	0.0	3.1875	OU	2.76	53.94	2240	71.43	YES	NO	-0.26	0.23	0.12	12.80
SE	44.00	77.5	2778.2	100.0	3.1875	OU	24.36	40.38	n.a.	40.8	NO	NO	16.12	0.19	0.07	10.70
UK	51.70	50.3	861.6	0.0	4.6875	OU	5.96	69.85	1720	48.3	NO	NO	37.96	0.20	0.13	12.30

*2010 data   *2012 data
**2009 data

Coding thresholds:

High	20	60	2000	50	4.67	0	40	60.84	2000	60	0	0	28.33	0.23	0.14	-1.27
Med	6 - 19	20-59	1000-1199	6-49	3.97	0	6-39	51.47	1000-1199	20-59	0	0	14.25	0.18	0.11	5.24
Low	5	19	999	5	3.27	0	5	42.10	2000	19	0	0	0.16	0.12	0.08	11.75

4.3 Functioning of the European gas market

The following references the gas markets dashboard in Table 4.3, with relevant time trends detailed in the Annex (see A2.2).

4.3.1 Market shares and concentration

Although high levels of market share of the largest gas operator >20 per cent) can be seen for 20 Member States (including the presence of a monopoly supplier in three Member States), it is difficult to interpret the market share of the largest producer in isolation, because the market structure depends on many factors (e.g., the level of gas endowments within a country, the infrastructure to import etc.). In the UK, the largest gas producer has a relatively low share of the market. This is because the UK has pursued strong liberalisation strategies, particularly in the upstream elements of the gas market (e.g., wholesale shipping for gas). These markets have been liberalised more completely than retail markets, a policy considered relatively successful[17].Retail gas markets remain highly concentrated in most Member States, even more so than electricity markets. In 18 Member States, the market share of the three largest suppliers exceeds 60 per cent, indicating high levels of concentration in these markets and the HHI is above the 2,000 threshold in many countries where data is available. The high level of concentration shows that retail competition in many countries is underdeveloped.

4.3.2 Vertical integration

Vertical integration is a strong feature of most national gas markets in the EU. In 18 Member States, the value of the OECD vertical integration was greater than 4 in 2013, suggesting high levels of vertical integration. Exceptionally in the UK, the gas market does not have a vertically integrated structure.

4.3.3 Regulation

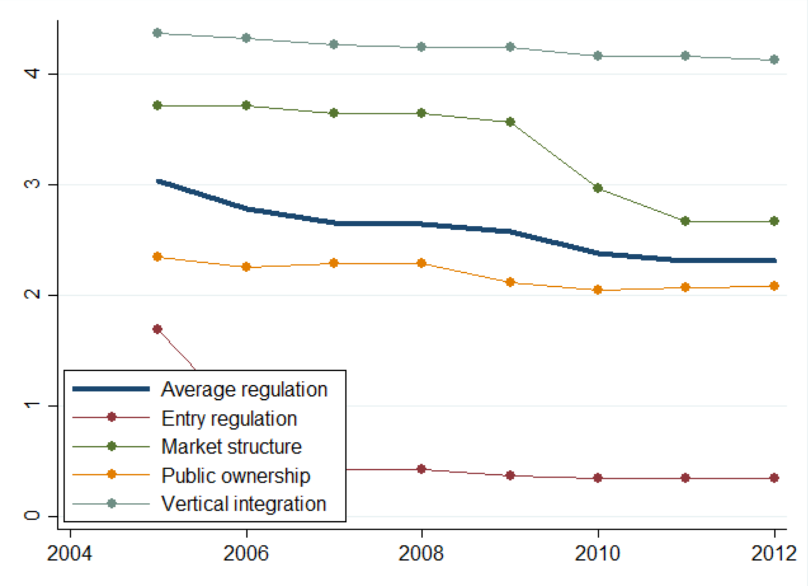
The overall level of regulation of gas markets is notably high in Bulgaria, Finland, Greece, Latvia and Poland, according to OECD data. Gas markets are fully liberalised in the UK and there is little regulation in Germany, Spain and Portugal.

The level of entry regulation, indicating the ease of entry into the market, is on average very low with an index value of 0.54 for the EU. In most Member States, this indicator is below 1, with the exception of Finland (4) and Latvia (5). Post-2007, this indicator has slightly increased from an average of 0.41 in 2007.

Figure 4.3 shows the average rates of regulation across Member States over time (2004 – 2012).Entry regulation is practically non-existent from 2006 onwards, while market structure regulation declines substantially after 2009. The levels of vertical integration and public ownership have remained more or less unchanged between 2004 and 2012.

[17] London Economics. 2012. ‘Energy Retail Markets Comparability Study’. *A report for DECC.*

Figure 4.3 Average rates of regulation across EU Member States in gas markets, 2004-2012



Based on DIW's analysis of OECD data

Many Member States continue to regulate retail gas prices. Price regulation in the household segment was prevalent in 14 EU Member States in 2013, while 11 countries also regulated prices for industrial customers. Most commonly a rate-of-return or cost-plus regulation is applied. All price regulation regimes use some kind of market reference in setting prices. Regulation with direct link to wholesale price exists in Denmark.

Finally, the latest information (2013) on ownership unbundling in gas markets shows that 15 Member States have chosen to apply the ownership unbundling model.

4.3.4 Public ownership

Eight Member States have high levels of public ownership of first generation producer (>50 per cent). Romania, Bulgaria, Denmark and Ireland all have significantly higher than average proportion of public ownership (all above 75 per cent).

4.3.5 Prices

There are significant differences in retail gas prices across the EU. In 2014, Romania had the lowest estimated household price in consumption band D2 (5.56 MWh < consumption < 55.6 MWh) (3.10 Eurocent/kWh), while Sweden had the highest price (11.86 Eurocent/kWh), causing a price differential ratio of 3.8 between the cheapest and the most expensive Member State in the EU. While this ratio is high, it shows a declining trend since 2011 when it was 4.2.

Overall, retail gas prices for households have increased by 35 per cent (EU average) between 2007 and 2014 (from 5 Eurocents /KWh in 2007 to 7 Eurocents/KWh in 2014) with an average year-on-year change of 4 per cent (higher than EU average inflation of 2.12 per cent). Almost all Member States recorded inflation-busting increases in retail prices during this period, with the exception of Hungary and Romania where retail prices fell. In these countries, end-user prices are regulated and are set below wholesale prices (see below).

When compared to 2013, retail gas prices for households on average fell by 2 per cent in 2014 across the EU.

Similar to prices for the household segment, there are large cross-country variations in prices (VAT and other recoverable taxes excluded) for industrial consumers across the EU. In 2014, the lowest estimated industrial price in consumption band I4 ((27,780 MWh < consumption < 277,800 MWh) was recorded in Belgium (2.69 Eurocent/kWh), while Greece had the highest price (4.30 Eurocent/kWh), causing a price differential ratio of 1.74 between the cheapest and the most expensive Member State of the EU. This ratio has decreased from 2.28 in 2007, indicating a gradual convergence of industrial prices.

Gas prices for industry on average increased by 34 per cent between 2007 and 2014. Compared to 2013, retail prices for industrial consumers on average fell by 8 per cent across the EU, causing a price differential ratio of 1.48 between the cheapest and the most expensive Member State in the EU. The wholesale price differential across the EU is lower for gas markets as compared to electricity markets.

Average wholesale gas prices ranged from 25.27 €/MWh in Hungary to 37.45 €/MWh in Lithuania (2013 data). Wholesale prices fell on average by 4 per cent across the EU between 2012 and 2013.

Significant gas price mark-ups could be observed in 10 Member States in 2013. In the UK and Luxembourg, mark-ups of more than 60 per cent over wholesale prices were recorded in 2013. Negative mark-up rates were noted in Romania, Poland, Lithuania, Hungary, Poland and Slovakia. These Member States are characterised by the existence of retail gas price regulation.

4.3.6 Switching

Switching rate among gas consumers is relatively low at 5 per cent (EU average). Higher switching rates are noted in Ireland, the Netherlands, Spain and Belgium (a similar country trend as seen in the electricity market).

Table 4.3 European gas markets – stylised overview

	Market characteristics																Market outcomes			
	Production and import market				Infrastructure			Wholesale market (i.e. hubs)	Supply market (i.e. Transmission)				Retail market							
	Public ownership of first generation producer (%)	Market share of 3 largest shippers (%)	Market share of 3 largest gas companies in power plants (by volume, %)	Market share of the largest entity brining in gas	Vertical integration indicator	Effective unbundling	Market share of 3 biggest gas storage system operators (%)	Traded volumes on European Gas hubs	Presence of cross-border entrants	Changes in number of players (%)	HHI in gas wholesale market	Average wholesale gas prices, (€/MWh)	HHI in gas retail market	Market share of 3 largest companies (by volume, %)	Price regulation - Households	Price regulation - non-households	Mark-up - wholesale to retail gas prices (EUR/MWh)	Retail price: Households (inc. taxes & levies)	Retail price: Industry (ex. VAT)	Switching rate
Year:	2010	2012	2013	2013	2013	2013	2013	2012	2013	2013	2013	2013	2013	2013	2013	2013	2013	2014	2014	2014
t range:	2010 only	2004 - 2013	2004-2013	2011 & 2013 only	2003, 2008, 2013	2010 & 2013 only	2008 - 2013	2003 - 2012	2013 only	2008-2013	2008-2013 av	2012 - 2013	2013 only	2004 - 2013	2008 - 2013	2008 - 2013	2012 - 2013	2007 - 2014	2007 - 2014	2008 - 2013
Source:	DG ECFIN	CEER	CEER	DG ENER	OECD*	DG ECFIN	CEER	IEA	Datamonitor	CEER	CEER	CEER	DG ENER	CEER	CEER	CEER	CEER	Eurostat	Eurostat	CEER
AT	31.50	90.00	n.a.	n.a.	4.69	ITO/ISO	73.00	47.30	n.a.	9.76	7,500	26.95	2,200	58.00	NO	NO	9.79	0.07	0.04	2.40
BE	n.a.	75.100	n.a.	n.a.	4.50	OU	100.00	66.60	84.08	126.67	1,709	26.97	3,900	69.33*	YES	YES	8.35	0.07	0.03	12.80
BG	100.00	100.00	n.a.	99.80	3.19	ITO	n.a.	n.a.	n.a.	0.00	7,587	32.05	1,000	83.00	YES	YES	5.34	0.05	0.03	0.00
CY				n.a.	*Do not have commercial gas network*															
HR	n.a.	93.00	89.00	60.80	3.38	n.a.	100.00	n.a.	n.a.	n.a.	5,987	35.07	1,588	72.55	n.a.	NO	5.79	0.05	0.03	0.00
CZ	n.a.	81.90	n.a.	82.30	4.50	ITO	100.00	n.a.	44.94	29.82	9,051	30.71	1,632	55.50	NO	NO	3.13	0.06	0.03	10.00
DK	76.00	n.a.	n.a.	n.a.	4.50	OU	100.00	n.a.	n.a.	-7.14	2,570	27.57	3,648	n.a.	YES	YES	8.89	0.09	0.03	9.60
EE	n.a.	100.00	100.00	86.50	4.13	OU	n.a.	n.a.	n.a.	7.41	10,000	33.37	7,943	98.00	NO	NO	0.48	0.05	0.04	9.00
FI	24.00	100.00	84.00	100.00	5.25	n.a.	n.a.	n.a.	n.a.	0.00	10,000	35.15	n.a.	79.00	NO	NO	0.60	n.a.	0.05	n.a.
FR	35.00	82.00	83.00	59.00	4.69	ITO	100.00	46.30	22.86	62.16	1,240	29.86	3,000	72.00	YES	YES	7.82	0.07	0.03	6.10
DE	n.a.	n.a.	35.6*	30.10	4.69	OU/ITO	68.00	221.40	0.50	0.00	1,982	27.22	300	28.5*	NO	NO	10.28	0.07	0.03	5.50
EL	65.00	100.00	100.00	88.60	4.69	ITO/OU	n.a.	n.a.	n.a.	16.67	5,181	32.24	n.a.	100.00	YES	YES	11.17	0.08	0.04	0.00
HU	22.00	100.00	86.26	32.91	3.19	ITO	100.00	n.a.	45.72	11.63	3,198	30.63	1,246	59.30	YES	YES	-7.63	0.04	0.03	0.00
IE	96.73	69.90	75.83	42.00	4.50	ITO	100.00	n.a.	n.a.	-12.50	1,215	25.27	4,780	66.00	YES	NO	11.25	0.07	0.03	17.70
IT	30.30	81.80	62.90	44.60	4.88	OU/ITO	100.00	64.70	9.58	5.43	2,093	30.91	1,275	46.80	NO	NO	9.55	0.09	0.03	5.50
LV	n.a.	100.00	100.00	100.00	4.50	n.a.	100.00	n.a.	100.00	0.00	10,000	32.14	10,000	100.00	YES	YES	-3.98	0.05	0.03	0.00
LT	n.a.	100.00	100.00	69.00	5.06	OU	n.a.	n.a.	n.a.	12.50	10,000	37.45	5,000	100.00	YES	NO	3.23	0.05	0.03	0.10
LU	25.00	100.00	100.00	n.a.	4.69	n.a.	n.a.	n.a.	4.06	-44.44	3,185	27.97	n.a.	99.00	NO	NO	18.43	0.05	0.03	0.00
MT				n.a.	*Do not have commercial gas network*															
NL	51.00	92.50	n.a.	n.a.	4.50	OU	100.00	187.90	59.46	41.94	2,488	27.19	2,258	97.00	NO	NO	9.24	0.08	0.03	13.10
PL	72.00	n.a.	100.00	96.90	4.69	n.a.	100.00	n.a.	n.a.	-62.11	4,550	30.50	9,073	94.90	YES	YES	-5.19	0.05	0.03	0.00
PT	8.00	98.30	100.00	85.30	2.25	n.a.	100.00	n.a.	8.68	-28.57	2,821	29.26	4,484	60.36	YES	YES	-0.53	0.10	0.04	0.00
RO	100.00	77.2*	69.51	41.70	3.19	ISO	n.a.	n.a.	45.14	1.03	3,270	28.52	n.a.	85.90	YES	YES	-14.19	0.03	0.03	0.00
SK	51.00	85.90	n.a.	61.80	4.50	ITO	100.00	n.a.	18.68	13.04	9,595	30.70	n.a.	73.00	YES	YES	-1.96	0.05	0.03	6.20
SI	39.00	99.26	n.a.	90.00	4.88	ITO	0	n.a.	7.18	9.52	5,027	31.03	4,186	69.60	NO	NO	2.14	0.07	0.04	5.10
ES	n.a.	70.00	78.70	48.00	3.00	OU/ISO	100.00	n.a.	2.20	10.96	2,000	27.27	2,264	n.a.	YES	NO	2.98	0.09	0.03	12.40
SE	n.a.	n.a.	n.a.	100.00	3.75	OU	n.a.	n.a.	6.68	33.33	2,766	33.30	n.a.	78.90	NO	NO	10.95	0.12	0.04	0.50
UK	n.a.	37.64	n.a.	17.00	0.00	OU	n.a.	1271.00	40.81	22.22	950	27.65	2,373	48.69	NO	NO	19.18	0.06	0.03	10.20
		*2012 data	*2012 data											*2012 data						

Coding thresholds:

High	50.00	40.00	40.00	40.00	5.18	-	40.00	-173.97	40.00	-24.66	2000.00	33.28	2000.00	40.00	-	-	12.47	0.09	0.04	-0.39
Med	6-394	6-39	6-39	6-39	4.067307692	-	6-39	272.1714286	6-39	10.37307778	1000-2000	30.26667797	1000-2000	6-39	-	-	4.81	0.07	0.03	5.05
Low	5.00	5.00	5.00	5.00	2.95	-	5.00	718.31	5.00	45.41	1000.00	27.25	1000.00	5.00	-	-	-2.85	0.05	0.03	10.49

4.4 Intensity of competition in European energy markets

We use the following two indicators to assess the intensity of competition in the energy markets: (i) productivity dispersion and (ii) the Boone Indicator. Each of these is describe below.

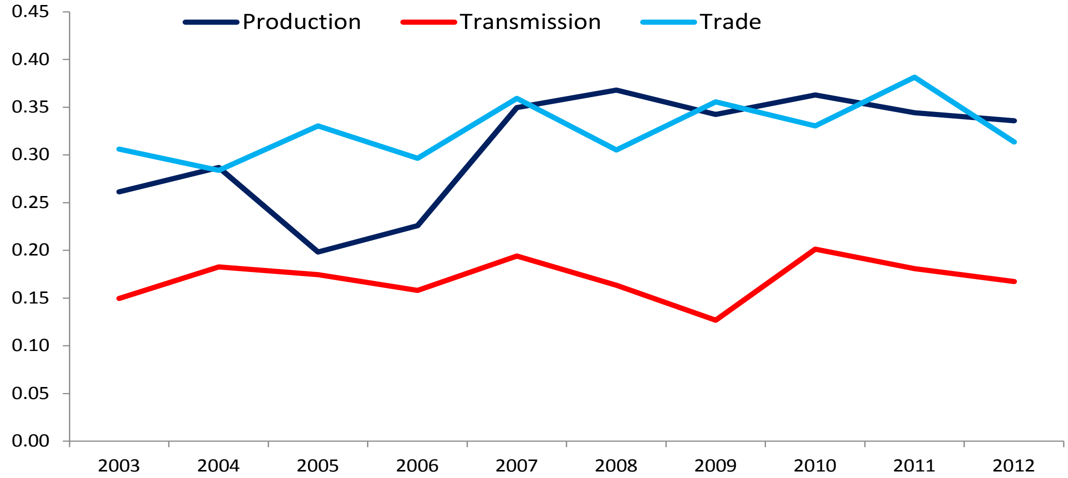
4.4.1 Productivity dispersion

Productivity dispersion can indicate how far competition drives productivity within a market by forcing inefficient firms to exit and allowing more efficient firms to enter. Lower levels of productivity dispersion are typically associated with a more competitive market. In a market with little competitive pressure, firms are less likely to be disciplined by a competitive selection process, meaning the productivity dispersion might be bigger: Very efficient and less efficient firms co-exist. Conversely, an increase in competition persuades firms to catch up with the technology leaders and forces inefficient firms to exit, thereby reducing the dispersion of productivities (Syverson, 2011).

Firm level data from Amadeus/Osiris was used to calculate this indicator (more detail is provided in Section 5.2). Our analysis shows that there is considerable variation in this indicator, both across segments (Figure 4.5) and across countries (Figure 4.5).

Average productivity dispersion is much higher in production and trade, as compared to the transmission segment of the energy supply chain. This may sound counterintuitive considering that the transmission segment is a regulated monopoly. But the relationship between productivity dispersion and competition is non-monotonic. It is possible that productivity dispersion is low in a particular industry because all firms are more or less equally non-productive or productive. Specifically, in the transmission segment, this indicator reflects the productivity differential between the limited number of companies that would be responsible for managing different parts electricity transmission lines and gas transportation pipelines, and not competing in the same geographic markets.

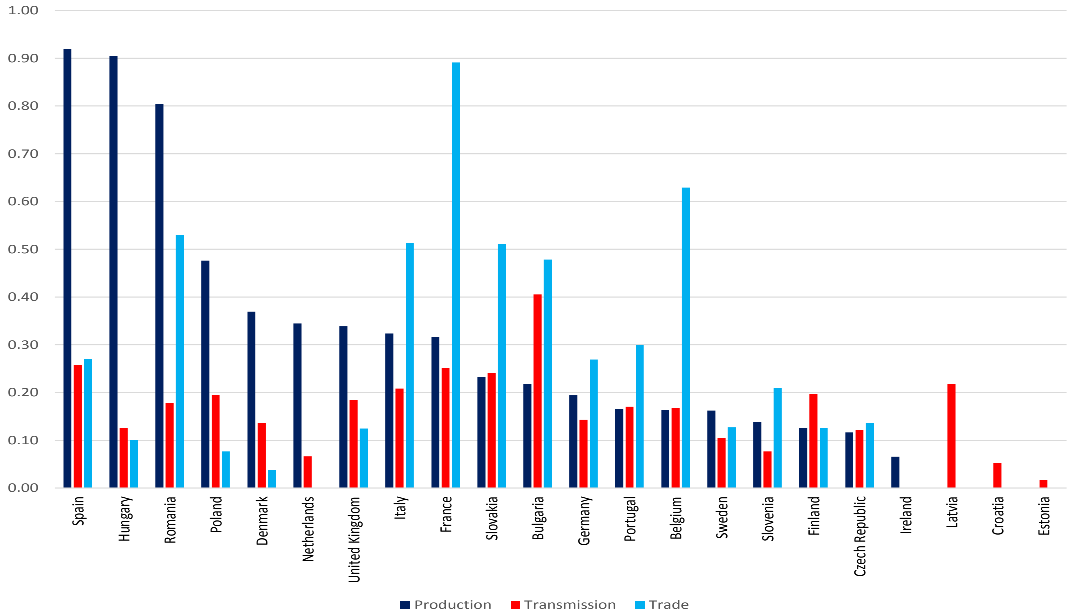
Figure 4.4 Productivity dispersion across different segments of the energy supply chain (EU averages), 2003-2012



DIW's estimations based on the Amadeus/Osiris database.

Significant differences in productivity dispersion can also be observed at a country level. In the production segment, productivity dispersion is noticeably high in Spain and Hungary, whereas high levels of productivity dispersion can be observed in the trade segment in France and Belgium.

Figure 4.5 Productivity dispersion in energy markets across EU Member States, 2012



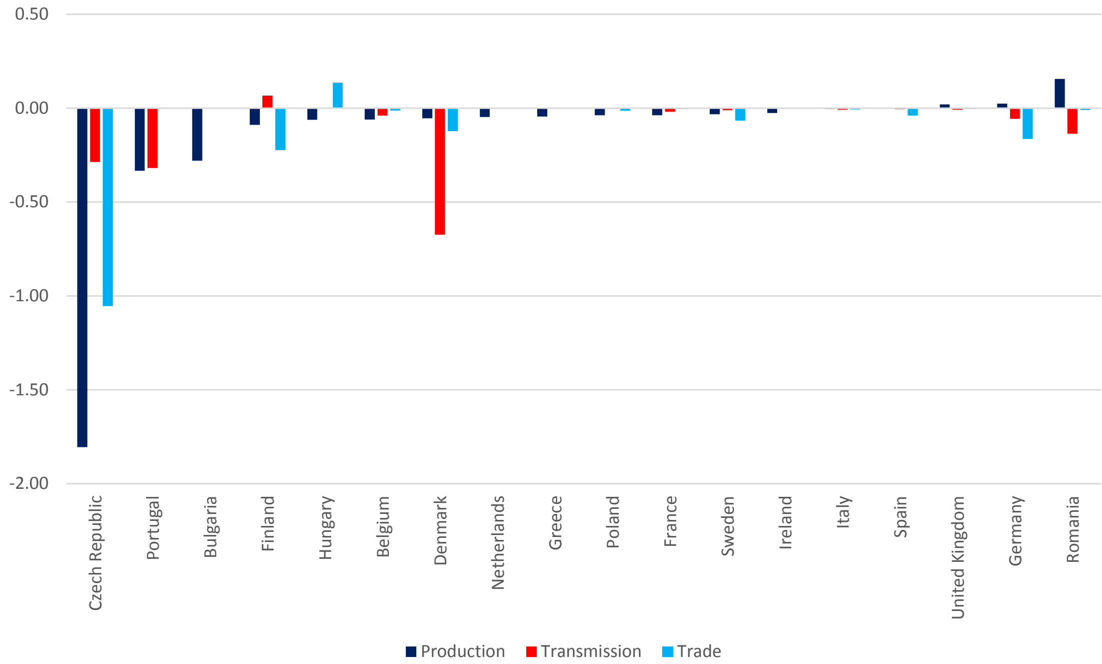
DIW's estimations based on the Amadeus/Osiris database. Data not available for Cyprus, Greece, Lithuania, Luxembourg and Malta and only partially available for Croatia, Denmark, Estonia, Ireland and Latvia.

4.4.2 Boone indicator

The **Boone indicator** – a measure of industry competition – is calculated as the elasticity of relative profits with respect to relative costs. The intuitive idea behind this indicator is that competition rewards efficiency. In other words, competition leads to a transfer of profits towards relatively more efficient firms (those with lower marginal costs) at the expense of less efficient ones. In this context, the higher the intensity of market competition, the harsher the punishment of relatively less efficient firms and the bigger the reward for relatively more efficient ones. Relatively efficient firms may see their profits fall as a result of an increase in competition, but in this case the reduction in profits is more severe for less efficient firms. In other words, a larger cost differential maps into a larger profit differential. Therefore, the more negative the Boone indicator, the higher the level of competition is in the market (because the effect of reallocation is stronger). The calculation of Boone indicator is further explained in section 5.2.

Due to limited data, this indicator could only be estimated at a national level for 18 Member States (Figure 4.6). Overall, the Boone indicator does not show much cross-country variation, except for the Czech Republic, which stands out as a comparatively competitive energy market.

Figure 4.6 Boone indicator – energy markets, 2012



DIW's estimations based on the Amadeus/Osiris database

Table 4.4 and Table 4.6 show the evolution of the above measures of competition. The mean standard deviations of firms' productivities are quite stable over years, with average values between 0.23 and 0.30. The Boone indicator shows more variation over time (Note that averages are negative in all years, as one would indeed expect profits to decrease in response to higher costs).

Table 4.4 Competition measures over time

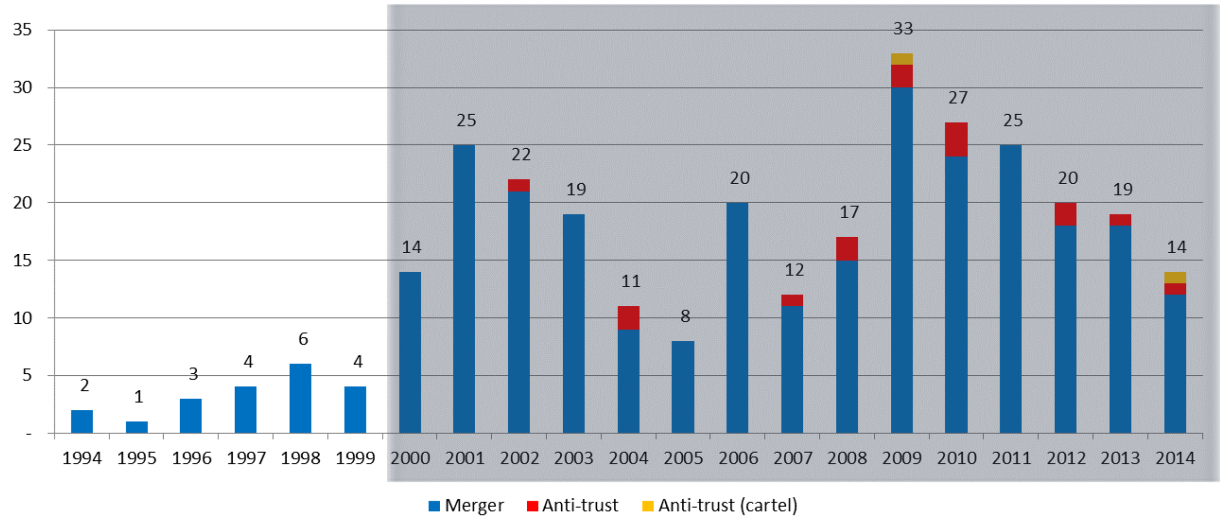
Year	Productivity dispersion		Boone indicator	
	Mean	S.D.	Mean	S.D.
2005	0.23	0. 20	-0.53	1.10
2006	0.23	0.20	-0.34	1.33
2007	0.30	0.29	-0.11	0.35
2008	0.27	0.29	-0.06	0.14
2009	0.27	0.32	-0.02	0.18
2010	0.29	0.29	-0.06	0.17
2011	0.30	0.29	-0.13	0.40
2012	0.27	0.22	-0.13	0.32

DIW's estimations based on the Amadeus/Osiris database

4.5 EU competition policy interventions: a descriptive overview

EU competition policy enforcement activity has increased since 2000 (when the first liberalisation directives were transposed in Member State legislation). Figure 4.7 shows the annual distribution of antitrust and key merger decisions. Overall, the Commission handled 351 cases in the energy sector (229 electricity; 122 gas) between 1994 and 2014 consisting of 313 merger cases and 38 anti-trust cases.

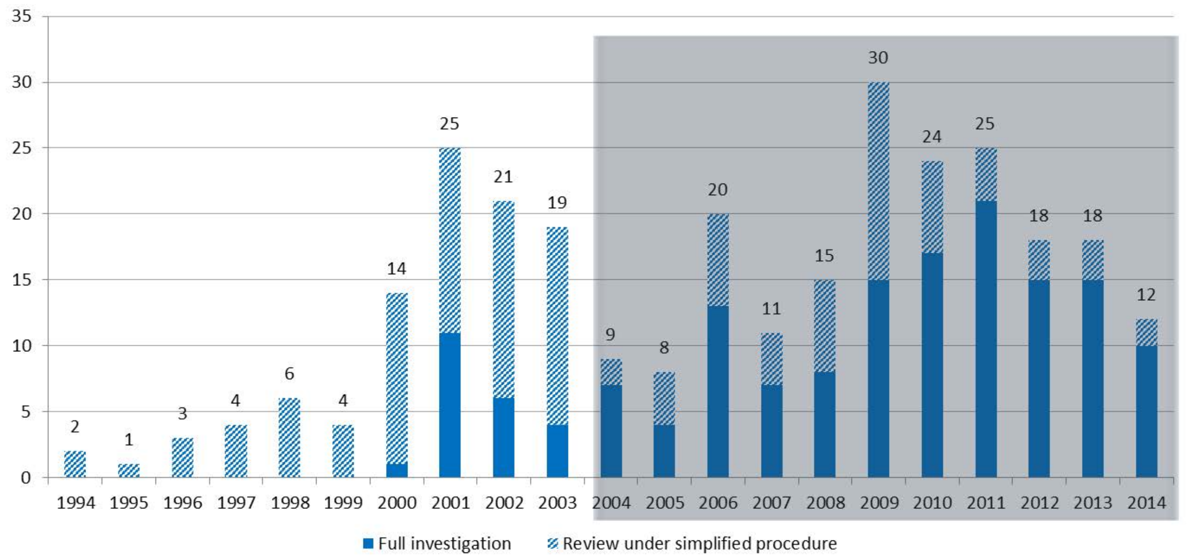
Figure 4.7 Distribution of EU merger and anti-trust cases in electricity and gas markets, 1994 - 2014



Source: DG COMP. Based on data extracted on 26/09/2014. NACE codes D35.1 and D35.2. NOTE: Sector inquiry excluded from anti-trust cases reported in 2007. By case end date.

Figure 4.8, shows that a significantly higher share of the merger cases in the energy sector have been subject to a full investigation since 2003.Previously, merger cases in the energy sector were subject to more simple procedures.

Figure 4.8 Distribution of EU merger cases, 1994 - 2014



Source: DG COMP. Based on data extracted on 26/09/2014. NACE codes D35.1 and D35.2. By case end date.

EU merger control has played a key role in improving market structure and functioning by *limiting further horizontal and vertical integration in energy markets* which are already highly concentrated. For example, the GDF/Suez merger (later examined as a case study) finalised in July 2008, which aimed to create one of the world's largest energy companies, would have, as originally planned, weakened competition in the gas and electricity wholesale and retail markets in Belgium and in the gas markets in France with the disappearance of competition between GDF and Suez in markets. Our case study demonstrates that the remedies offered by GDF and Suez were effective in limiting the potential anti-competitive effects of the merger (in Belgian wholesale gas markets, the focus of study) and that ownership unbundling improved access to the hub.

In case of the Electricité de France S.A. (EdF)/British Energy merger decision (2008), the package of remedies secured by the Commission aimed to *prevent unilateral horizontal effects*. This merger combined British Energy, the UK's largest power generator, and EDF, another significant UK electricity player with substantial coal- and gas-fired generation capacity. Although the new entity would not have had very high market shares and faced a number of competitors, the Commission's investigation identified concerns. Specifically, that the transaction created the possibility for the merged entity to net-off its generation and supply requirements, thereby precluding the need for British Energy to sell most of its generation into the wholesale market and for EDF to buy power in the wholesale market.

The Commission believed this could lead to a reduction of liquidity in the British wholesale electricity market, potentially resulting in demand foreclosure for generators, increased difficulties for generators and suppliers to hedge their positions, increased market volatility and less reliable price signals (with attendant impact on generators' ability to secure financing for new projects). The merger was ultimately cleared by the Commission on the basis of a package of structural and behavioural remedies provided by EdF.

In some cases, the *remedies put in place to mitigate the potential anti-competitive effects of a merger have also contributed to promoting market liberalisation.* For example, in 2001 the Commission authorised, subject to conditions, the acquisition of joint control of German electricity company Energie Baden-Württemberg AG (EnBW) by EdF and Zweckverband Oberschwäbische Elektrizitätswerke (OEW), an association of nine south-west German districts.

The investigation concluded that EdF enjoyed a dominant position on the French market for the supply of eligible customers, with a market share of approximately 90 per cent. EnBW was considered one of the most likely potential competitors in the French market and was strategically well-placed to enter the market for the supply of eligible customers.

By acquiring EnBW, EdF would have strengthened its dominant position in France and also increased its potential for retaliation in Germany and would thus become less exposed to competition in France.

There were two relatively standard elements to the remedies package and an innovative third element. This third element of the EdF remedy sought to address the competition concerns in relation to so-called "eligible" customers in France, i.e., those whose electricity supply is open to competition. To resolve these concerns, EdF undertook to provide competitors with access to generation capacity located in France in the form of virtual power plants (5000 MW) and back-to-back agreements to existing co-generation power purchase agreements with a maximum of 1000 MW.

According to the terms of the commitments, the contracts for access to the virtual power plants were to be awarded through a non-discriminatory public auction open to both utilities and traders. These arrangements for access to generation capacity were to remain in place for five years to allow sufficient alternative supply sources to become available

The Commission has not hesitated in *prohibiting anti-competitive mergers*. In 2004, the Commission decided to prohibit the proposed acquisition of joint control over Gás de Portugal (GDP), the incumbent gas company in Portugal, by Energias de Portugal (EDP), the incumbent electricity company in Portugal, and ENI, an Italian energy company.

The Commission analysed the possible impact of the proposed operation on the gas and electricity supply markets in Portugal and concluded that the transaction would strengthen EDP's dominant position in the electricity wholesale and retail markets in Portugal. In particular, it would remove GDP's potential to compete in the electricity markets. Because gas is also now one of the most efficient ways to produce electricity, the concentration would have made current and possible future power producers in Portugal dependent on their main competitor, namely EDP. The concentration would also strengthen GDP's dominant position in the relevant gas markets in Portugal, through the foreclosure of a significant part of the gas demand (controlled by EDP) and the elimination of EDP as most likely entrant in the gas markets.

Since most competition in energy markets comes from electricity incumbents entering the gas market and vice versa, this case demonstrates the Commission's strict approach to *mergers involving gas and electricity companies ('convergence' mergers).*

The Commission's intervention has also *prevented mergers with potentially anti-competitive effects* from going forward. In 2008, the proposed acquisition of the Hungarian oil and gas company, MOL by the Austrian oil and gas group, OMV was abandoned following the Commission's concerns relating to the combined market share of the companies in several energy markets. The proposed acquisition would have brought together two strong integrated oil and gas companies and given the merged entity a strong hold in both the petrol retail market and in the refining sector in several Central and Eastern European (CEE) countries. OMV offered a number of remedies (for example, offering to open the refineries to competitors) to address the competition concerns raised by the Commission, but these were deemed insufficient. OMV was not prepared to accept the remedies sought by the Commission and eventually withdrew the merger notification.

Finally, the Commission has also *acted when the conditions imposed by national authorities create unjustified restrictions to mergers of Community dimension*. In particular, the Commission has adopted three decisions under Article 21 of the Merger Regulation (two in the framework of the E.ON/Endesa case and one in the Enel/Acciona/Endesa case) to declare that some measures adopted by the Spanish authorities were incompatible with community law, constituted unjustified restrictions to those mergers and should, therefore, be withdrawn.

Given the Spanish authorities' failure to comply with the Commission request to withdraw the illegal measures, the Commission began infringement proceedings under Article 226 EC in the two cases. The European Court of Justice has recently clarified that in relation to the first one of these infringement cases (EON/Endesa) Spain violated EC law by failing to comply with the Commission decisions adopted on 26 September and 20 December 2006.

The Commission has taken antitrust enforcement action to tackle *exclusionary conduct by dominant incumbents; exploitative abuses by dominant incumbents*; and *collusive behaviour*. For example, in 2007, the Commission opened an investigation into ENI's suspected abuse of a dominant position in the market for the transport of gas. There were concerns that ENI may have foreclosed competition in the Italian gas supply market by not granting competitors' access to capacity available on the transport network (capacity hoarding) or doing so in an impractical way(capacity degradation) and by strategically limiting investment in ENI's international transmission pipeline system(strategic underinvestment).

In response, ENI committed to divest its shares in the three companies operating the relevant international transport pipelines[18], thus ensuring that third-party requests to access the gas pipeline would be dealt with by an entity independent of ENI, thereby removing the potential conflict of interest resulting from the vertical integration of ENI.

In 2007, the Commission initiated antitrust action against Distrigas in response to potential market foreclosure concerns relating to long-term gas supply contracts between Distrigas, the Belgian incumbent national supplier, and its large gas customers in Belgium. Given the strong market position of Distrigas in the relevant market, the Commission was concerned that other suppliers would find it difficult to do business with Belgian customers, due to the combination of two factors: the duration of the contracts and the volumes of gas tied to Distrigas.

To address the Commission's concerns, Distrigas proposed a series of commitments for four years. It was to ensure that no more than 35 per cent of its volumes sold to large industrial users and electricity producers (representing about 20 per cent of total sales in the relevant

18 Namely: TAG, TENP and Transitgas, which bring gas to Italy from Russia (TAG) and northern Europe (the TENP/Transitgas system)

market) would be contestable every year. In addition, the duration of all new contracts would be limited, with a maximum of five years applying to contracts with industrial users and electricity producers, and a maximum of five years applying to gas resellers

In the electricity sector, the Commission investigated E.ON's suspected abuse of its dominant position on the German wholesale market (2008). There were concerns that E.ON may have withdrawn available generation capacity from the German wholesale electricity markets (to raise prices), and may have deterred new investors from entering the generation market.

The case resulted in substantial commitment by E.ON to divest 5000 MW of generation plants along with its extra-high voltage distribution network that structurally changed the German electricity market to the benefit of consumers (see later case study).

Antitrust enforcement in the electricity sector has also included interventions to prevent restrictions on trade in electricity between EU countries (e.g. Swedish interconnector's case, 2010).

The European Commission has tackled collusive behaviour in both gas and electricity markets:

- In July 2009, the Commission issued a Decision fining both E.ON and GDF Suez for having colluded to share the German and French gas markets.
- In 2014, the Commission fined EPEX Spot and Nord Pool Spot – the two leading European spot power exchanges – for agreeing not to compete with each other.

Table 4.5 provides an overview of some of the cases handled by the Commission in the energy sector. These cases illustrate the range of competition issues covered by EU competition policy intervention and the significance and variety of commitments secured from the entities concerned.

Table 4.5 Illustrative examples of competition concerns addressed by EU competition policy interventions

Relevant instrument	Case (year)	Competitive concerns	Remedies / commitments undertaken	Decision
VERTICAL INTEGRATION				
Article 102 TFEU	AT.39315 – ENI (2010)	Foreclosing practices by vertically integrated firms - Italy The Commission notified ENI that it may have been abusing its dominant position on the gas transport markets by: refusing to grant competitors access to capacity available on the network; by granting access in an impractical manner; and, by strategically limiting investment in ENI's international transmission pipeline system. There were also concerns ENI may have had incentive to engage in a strategy of foreclosing rivals to protect its margins in downstream gas supply market.	ENI made commitments to sell international transport pipelines and divest shareholdings in TAG. This aimed to ensure access was granted fairly amongst competitors (as dealing with entity independent of ENI).	Commitment decision approved.[19]
Article 102 TFEU	AT.39316 – GDF (foreclosure) (2010)	Foreclosing practices by vertically integrated firms - France GDF Suez held a dominant position on the gas importation and supply markets in the two balancing zones in France (North and South of the GRTgaz transport network). GDF Suez allegedly abused its dominant position by foreclosing access to gas import capacities in France, restricting competition on the supply markets. Particular concerns were raised in regards to: the long-term reservation of most gas import capacity in France; the determination of reception capacity and the procedures for allocating long-term capacity at the new Fos Cavaou LNG terminal; and, the strategic limitation of investment in additional import capacity at the Montoir de Bretagne LNG terminal.	GDF Suez committed to: ▪ provide for the rapid release of significant firm long-term import capacities in the balancing zones of the transport network concerned; and, ▪ to limit its capacity reservations to under 50 per cent of total firm long-term import capacity in France for a period of ten years (from 2014 the latest).	Commitment decision approved.
Article 102 TFEU	AT.39317 – E.ON gas foreclosure (2010)	Foreclosing practices by vertically integrated firms - Germany E.ON allegedly abused its dominant position on the gas transport markets (in its L-gas network and the H-gas market area NetConnect Germany) by foreclosing access to entry capacity into its gas transmission grid. The long-term bookings on E.ON's gas transmission network disabled access for competitors and restricted	E.ON proposed to commit to the followings: ▪ release a volume of 17,8 GWh/h firm, freely allocable entry capacities by October 2010; ▪ reduce its overall share in the	Commitments decision approved

19 According to Article 9 of Regulation 1/2003 (the EU antitrust law), the Commission may decide in cases where it intends to conclude antitrust violations to make commitments legally binding on companies that offer them. These, so-called Article 9 settlement decisions allow the Commission to resolve competition concerns more rapidly. Because they represent a settlement, Article 9 decisions do not conclude on the existence of an infringement. But were a company to break legally binding commitments, the Commission could impose a fine of up to 10% of the total annual turnover without having to prove the violation.

Relevant instrument	Case (year)	Competitive concerns	Remedies / commitments undertaken	Decision
		competition on the downstream gas supply markets.	bookings of firm and freely allocable entry capacity in the H-gas market area (NetConnect Germany) to 50 % by October 2015 and for the L-gas network to 64 % by October 2015 (and not exceed these thresholds until 2025).	
Article 102 TFEU	AT.39351 (2010)	Abuse of dominant market position - Sweden The Commission was concerned that Svenska Kraftnät (SvK), the Swedish transmission system operator, may have been breaching EC Treaty antitrust rules on the abuse of a dominant market position (Article 82). Particularly, there were concerns that SvK were limiting the amount of export transmission capacity available on electricity interconnectors situated along Sweden's borders, with the objective of relieving internal congestion on its network.	SvK committed to subdivide the Swedish electricity market into two or more Bidding Zones and operate the transmission sytem on this basis (committing to a deadline of Nov 20110. They also committed to reinforce the West Coast Corridor by building and taking into operation a new 400 kV transmission line.	Commitments decision approved.
HIGH LEVELS OF CONCENTRATION				
Regulation 139/2004	M.4180 – GDF / Suez (2006)	Unilaterally exercising market power – Belgium and France The proposed merger between GDF and Suez group affected both the gas and electricity markets in France and Belgium. In the case of Belgium, the merger (as originally planned) would have resulted in **very high combined market shares** and would have removed GDF as the strongest competitor to the incumbents Distrigaz (gas) and Electrabel (electricity and gas). In France, it would have **strengthened GDF's dominant position in France.** Other impacts in terms of barriers to entry were also identified.	The parties offered a set of commitments to neutralise competition concerns: ▪ Suez to divest Distrigaz (including its French activities) and relinquish control over Fluxys; ▪ GDF to divest its shareholding in SPE and, to address the concerns in the district heating market, divest its subsidiary Cofathec Coriance; and ▪ a series of investment projects will be carried out both in Belgium and in France which should increase infrastructure capacities, thereby facilitate new entry and	Merger approved subject to commitments.

Relevant instrument	Case (year)	Competitive concerns	Remedies / commitments undertaken	Decision
			competition. (most importantly the Zeebrugge hub to be enhanced to link all networks converging on Zeebrugge through an independent operator, Fluxys).	
Regulation 139/2004	M.2947 – Verbund / Energie Allianz (2003)	Unilaterally exercising market power – Austria A joint venture was proposed between Verbund and EnergieAllianz in the Austrian electricity market. Verbund was a vertically integrated electricity company generating around half of the electiricity consumed domestically. EnergieAllianz was already a joint venture of Austrian electricity distributors. It was found that by combining Austraia's main electricity producer with five of its regional electricity distributors, the transaction would lead to a high combined market share in the electricity generation and supply markets. This market power was deemed strong enough for electricity prices to be raised above the competitive level for both household and industrial customers.	The parties undertook the following commitments; ▪ Verbund to sell its 55% shareholding in APC (a company that deals with large customers with a share of 10-15% of the Austrian market); ▪ Verbund not to exercise important voting rights in the Styrian regional supplier Steweag-Steg; ▪ to auctioned each year until July 2008 a volume of electricity totalling 450 gigawatt-hours (including 50% hydroelectricity); and ▪ to set an interim price cap on balancing energy.	Merger approved subject to commitments.
PRICE FORMATION MECHANISMS – USE OF LTC's				
Article 101 TFEU	AT.39386 – Long term electricity contracts in France (2010)	Lack of liquidity on wholesale markets and the foreclosure of downstream markets – France The Commission launched an investigation suspecting EDF may have abused its dominant position on the market for electricity supplies to large industrial users by concluding contracts which closed off access to this market for other potential suppliers due to these contracts' scope, duration and exclusive nature. They were also concerned EDF may restrict resale by its customers of the electricity it supplied.	EDF committed to: ▪ ensure competitors could compete for 65% of the electricity it contracts with large industrial users in France; and ▪ make two distinct contractual offers to its customers, allowing customers the choice to partly source electricity needs from another supplier.	Commitment decision approved.

Relevant instrument	Case (year)	Competitive concerns	Remedies / commitments undertaken	Decision
Article 101 TFEU	AT.37966 – Distrigaz (2008)	Lack of liquidity on wholesale markets and the foreclosure of downstream markets – Belgium Distrigaz (a member of the Suez group) concluded long-term gas supply agreements in Belgium. The Commission was concerned that these long-term supply agreements set back consumer switching. The long term contracts allegedly foreclosed the market by preventing suppliers from competing with Distrigaz for the consumers locked-in by these contracts.	Distrigaz undertook the following commitments: ▪ ensure that each year on average a minimum of 70 % of the gas volumes supplied by Distrigas and connected undertakings to industrial users and electricity producers will return to the market, and thereby alternative suppliers can make a competing offer to the customers concerned; ▪ contracts with industrial users and electricity producers will not be longer than five years (but contracts relating to new power plants with a capacity exceeding 10 MW are not subject to the commitments); ▪ gas supply agreements with resellers will not last longer than two years; ▪ no restrictions will be part of the supply contracts.	Commitment decision approved.
Article 101 TFEU	AT.36559 – British Gas et. al. (2002)	Lack of liquidity on wholesale markets and the foreclosure of downstream markets – United Kingdom and Germany The Commission were notified of two contracts according to which EDF Trading would supply WINGAS (a joint venture between BASF of Germany and Gazprom) over a period of 10 years with a possibility of extension for a further five years. The volumes concerned corresponded to 20 per cent of WINGAS total annual gas purchases and two per cent of the total annual gas consumption Germany. Competition concerns were raised due to a clause allowing WINGAS to reduce the volumes bought in case EDF Trading would sell gas into WINGAS main supply territory. Within this clause, sales to new market participants in the German market	Following discussions, the parties amended the contract in a way that the mechanism creates a level playing field between the incumbents and new entrants and therefore the Commission cleared the notified gas supply contracts.	Commitment decision approved.

Relevant instrument	Case (year)	Competitive concerns	Remedies / commitments undertaken	Decision
		were not adequately exempt which raised entry barriers.		
BALANCING REGIMES				
Article 101 & 102 TFEU	AT.39389 – German electricity balancing market (2009)	Abuse of dominant position on balancing market by favouring own production affiliates, restricting access of other affiliates and raising prices for access to the network - Germany The Commission investigated the German electricity market following the energy Sector Inquiry in 2007. Relevant to balancing regimes, the Commission felt E.ON may have abused its dominant market position as a transmission system operator on the secondary electricity balancing market. The Commission had concerns that E.ON prevented other power producers from selling balancing energy into the E.ON markets.	E.ON proposed the divestiture of its transmission system business and the related activities.	Commitment decision approved.
COLLUSIVE BEHAVIOUR				
Article 81(1) EC	AT. 39401 (2009)	Suspected collusion – France and Germany GDF had a monopoly on the import of gas into France. Following the removal of the import monopoly and during the gradual liberalisation of the European gas markets, GDF and E.ON continued to apply the 1975 side letters, meeting on a regular basis and discussion implementation of the agreement in the newly liberalised markets. The duration of the infringement was from at least 1 January 1980 until 30 September 2005 in Germany and from 10 August 2000 to 30 September 2005 in France.	The Decision required E.ON, E.ON Ruhrgas and GDF Suez to bring the infringement to an end to the extent they had not already done so (at the time of the decision) and to refrain from repeating any act or conduct having the same or equivalent undertakings. A fine of € 553 million was imposed on each E.ON Ruhrgas, jointly and severally with E.ON, and GDF Suez.	E.ON Ruhrgas, E.ON and Gaz de France (now GDF Suez) had infringed Article 81(1) EC by participating in an agreement and concerted practices in the natural gas sector in France and Germany.
Article 101 of TFEU and Article 53 of EEA Agreement	AT.39952 (2014)	Non-competitive arrangements covering electricity spot trading services - France, Finland, Norway and Sweden EPEX (in France) and NPS (in Finland, Norway and Sweden) engaged in non-competitive arrangements covering all their electricity spot trading services in the EEA and beyond. The aim was to restrict competition between them, to protect their traditional strongholds, and agree on expansion to new countries while maintaining the power balance between them. The agreement included an allocation of territories.	Fines were issued to EPEX of €3,651,000 and for Nord Pool €2,328,000.	EPEX and Nord Pool were engaging in non-competitive arrangements impacting the EEA and byoned.

4.6 Summary of key findings

The main observations that can be drawn from the data presented in this section are as follows:

- Overall European gas and electricity markets remain highly concentrated, although there are significant differences at a national level. Particularly high levels of market concentration can be observed in small countries such as Bulgaria, Cyprus Estonia and Malta. Member States such as Germany, Finland, Italy, Netherlands and the United Kingdom, on the other hand, exhibit relatively low levels of market concentration.
- While progress has been made in liberalising markets, the positon varies across Member States:
    - Many Member States continue to regulate end-user prices and there is still insufficient separation of infrastructure and supply functions in energy markets.
    - Although the level of vertical integration has- on average – been declining across the EU over the last decade or so, it remains reasonably high, particularly in gas markets.
    - Public ownership of the first generation producer remains high in many Member States in both gas and electricity markets.
- Wholesale prices have declined significantly for electricity and remained stable for gas.
- Gas and electricity prices have been rising for consumers (except in 2014 when prices fell) and high levels of mark-ups can be observed in a number of Member States.
- Productivity dispersion has remained stable overtime, although the Boone Indicator suggests that the intensity of competition in European energy markets has declined between 2005 and 2012.
- Switching levels are generally very low across Europe, with the exception of a handful of Member States.

Alongside the above market developments, one can also observe an increase in EU competition policy enforcement activity overtime and particularly since 2000. The extent to which there is correlation or causality between some of the market developments noted above and EU competition policy enforcement is examined in the next section using econometric approaches. An interesting point to note is the divergence between retail and wholesale prices which in some Member States, could potentially be attributed to factors which cannot be influenced by competition policy (such as rising taxes and network costs, and the continued regulation of energy prices to many European households), but this divergence could also be indicative of markets not working well. The case study presented in section 6 specifically examines the relationship between wholesale and retail prices in the German electricity market in the context of a specific Commission Decision addressing alleged abuse of dominant position by E.ON.

5 Impact of competition policy enforcement on the functioning of EU energy markets

The overall framework for the empirical analysis is based on the following relationship between policy enforcement, i.e., competition policy and regulatory interventions, and market outcomes:

- First, competition policy enforcement has a direct impact on strategic interactions between firms in the involved markets and affects competition (Aghion and Schankerman, (2004)).
- As a result of changes in competitive pressure, firms adapt their investment behaviour. Investment provides a good outcome variable because many studies show that firms facing stronger competition make substantial investments to raise productivity (Holmes and Schmitz, (2010)). Investment is particularly relevant as an outcome variable in the energy markets because it is widely accepted that more investment is needed in Europe's energy sector to ensure security of supply and to improve efficiency. To meet the EU's ambitious climate and energy targets and at the same time secure the provision of energy, Member States are expected to increasingly invest in electricity generation, particularly in renewable energies, and in electricity grids and natural gas infrastructure (e.g., Hirschhausen et al. (2014)). To incentivise investments in cross-national infrastructure projects such as interconnector transmission grids, and also to spur national investment in generation capacity. Measures of investments are therefore pivotal variables to consider in understanding how competition and regulatory policies affect energy markets.
- Changes in market competition and firms' investment behaviours have an impact on long-term outcomes such as firms' productivity. There is strong empirical evidence to show that competition can drive greater productivity (CMA (2015)). Change in investment should also directly lead to changes in productivity (e.g., Lichtenberg and Siegel, 1991). Productivity-based variables can therefore be seen as appropriate measures of long-term competitive outcomes, which capture the selection effects of competition as a process. According to the literature, there are three main channels through which higher competition could lead to higher productivity: (i) within firms, competition acts as a disciplining device, placing pressure on the managers of firms to become more efficient. This decreases 'x-inefficiency' - the difference between the most efficient behaviour the firm is capable of and its observed behaviour in practice. This is sometimes called the 'within-firm' effect; (ii) competition increases productivity by forcing inefficient firms to exit, by allowing more efficient firms to enter, and by reallocating resources from inefficient to efficient firms. Market forces may cause inefficient firms to exit and may cause a reallocation in market shares from inefficient to efficient firms. These effects are generally called the 'between-firms effects'; and (iii) competition drives firms to innovate. Innovation increases dynamic efficiency through technological improvements of production processes, or the creation of new products and services (CMA (2015)).

There is another, indirect channel through which policy enforcement impacts long-term market outcomes. Each specific policy intervention does not only affect the firms and markets directly involved in the specific case, it also has important indirect effects due to spill-overs across (vertical) markets, as well as deterrent effects (e.g., Buccirossi et al. (2013); Clougherty and Seldeslachts (2013); CMA (2015); Duso et al. (2013); Seldeslachts et al. (2009)). For example, specific policy decisions affecting investment in electricity generation capacity, also affect incentives and market outcomes in transmission and distribution. Similarly, the enforcement of antitrust rules sends signals about the strength of the antitrust authorities[20].

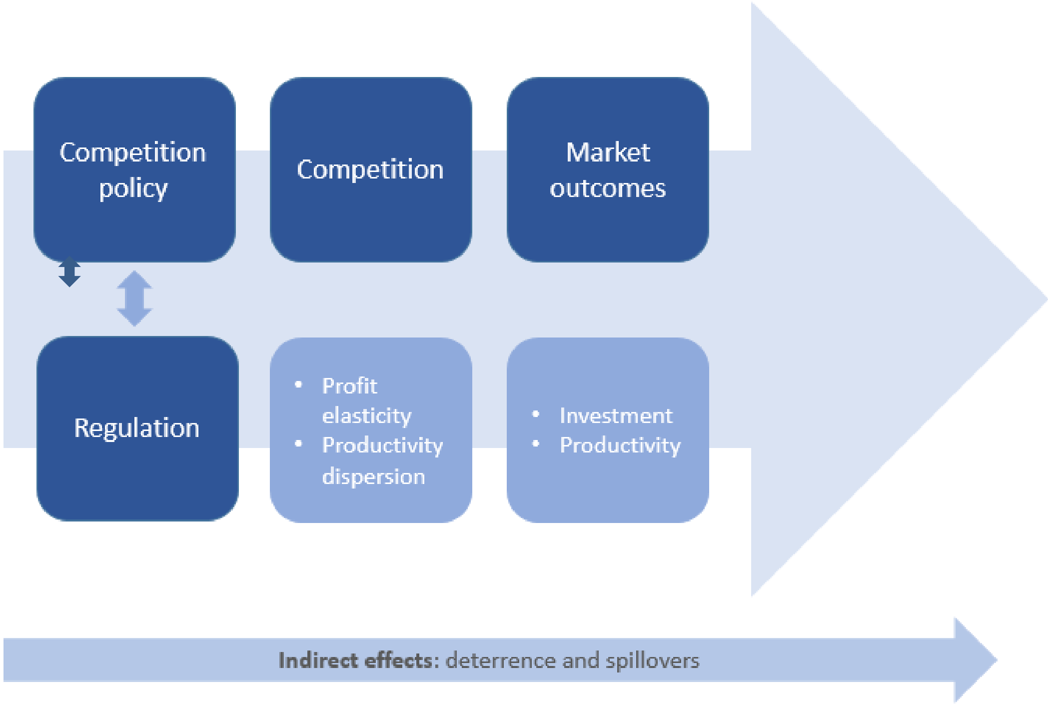
[20] In 2011 the OFT commissioned research from London Economics to estimate the impact of enforcement on deterrence, based on surveys of businesses and advisors. The research estimated that investigations into abuse of dominance could be expected to deter 12 other instances of potential anti-competitive behaviour,

Consequently, a particular decision affects not only the firms involved in that case, but also other firms' behaviour in the same and other markets. These indirect effects are recognized to be important elements of competition policy enforcement and cannot be measured when only evaluating single decisions (Joskow (2002)).

Alsena et al (2005) look at the effects of deregulation on investment in transport, communication and utilities (electricity and gas) sectors. They find that competition enhancing regulatory reform (such as liberalisation of market entry) has had a significant positive impact on investment in these sectors. However, it has not yet been investigated how competition policy and regulation interact in determining competition and market outcomes.

Our framework, summarised in Figure 5.1 captures direct and indirect effects of competition policy and illustrates how competition policy and regulation interact in determining outcomes.

Figure 5.1 Framework: Competition policy & regulation, competition, and market outcomes



Source: own figure

The broad econometric analysis presented in this chapter provides empirical evidence for several channels highlighted in the above framework.

It specifically analyses the impact of EU-wide and national competition policy enforcement, and regulation, on the intensity of competition and market outcomes. It focuses on long-term performance variables such as the intensity of competition, investment, and productivity rather than on more specific, short-term measures such as wholesale and retail prices. The latter variables are the main focus of the case studies presented later. . The econometric analysis in this section identifies the broad impact of the different policy interventions and compliments the specific case-study analysis in the following chapters. This section also looks at the effects of the interaction between competition policy enforcement and product market regulation. Both types of policies can be expected to influence market outcomes, yet little is known about their interdependencies.

while investigations into potentially anti-competitive commercial agreements could deter similar behaviour in another 40 cases.

5.1 Data and variables used for the econometric analysis

The econometric analysis is based on data on competition policy enforcement (our main explanatory variables) and measures on regulation, competition and market outcomes. Information from various sources and at different levels of aggregation was merged Measures of competition policy enforcement at the EU and national levels were specifically collected for this study from the European Commission (DG Competition) website and through tailored questionnaires sent to the national competition authorities.

Regulation data were collected from the OECD regulation database. Data on firm-level measures come from the Bureau van Dijk's Amadeus/Osiris database. Additional control variables were collected from the World Bank, OECD, and European Commission. Data sources and the main variables used in the study are described below.

5.1.1 Policy enforcement data

5.1.1.1 EU competition policy enforcement data

A detailed dataset on EU competition policy enforcement between 2005 and 2013 in energy markets[21] was created to quantify the Commission's activities. There are 200 key merger decisions, 17 antitrust decisions (16 abuses and 1 cartel) and 203 state aid decisions concerning energy markets in the relevant sample period.

From these documents, we constructed indicators of competition policy enforcement at EU level. This was then transformed to match the national level of analysis proposed in this study, i.e. the Member State/year unit of observation, as energy markets still mainly function at national level.

In state aid cases, and in most of the antitrust cases generally, only one country is involved. Therefore, this case is supposed to only affect that particular geographic national market and it is 'allocated' to the particular Member State involved. Mergers are often more complex. In most cases, the geographic market definition is not national. We therefore identified the geographic markets involved. If the market definition was broader than national, we allocated the case to all Member States involved in that decision. If the market definition was EU-wide, all EU countries in our sample are considered to be affected by the decision. If the market definition was left open, we allocated the case to the country of origin of the merging firms.

In merger cases, we define 'intervention' as follows: remedies (in phase 1 or phase 2) and merger withdrawals during phase 2. While prohibitions should be considered the most extreme form of intervention, no merger was prohibited during the sample period in the energy sector.[22] In the case of state aid, we define an intervention as the decision to initiate a formal investigation.[23] For abuses and cartels, we simply use the number of cases as a measure of intervention, since all led to remedies or fines.[24] Table 5.2 summarises the indicators of activity and EU competition policy enforcement.

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[21] The Commission publishes all official decisions on its webpage (http://ec.europa.eu/competition/index_en.html). We downloaded all cases with NACE code D. This broader market definition can be narrowed to focus on electricity (D.35.1) and gas (D.35.2) markets only. We used the decision date as the criterion for the selection. We downloaded all cases where the Commission's decision was made between January 1st 2005 and December 31st 2013.

[22] Three mergers that were eventually withdrawn by the firms were coded as cases in which the Commission intervened. One case that was referred to a member state was dropped from the data.

[23] DG Comp's officials agreed that this is the best (though imperfect) indicator of intervention in this area

[24] We further collected additional data on fines imposed. However, these EU data are too sparse for econometric analysis and are therefore left out.

Table 5.1 EU competition policy enforcement at the member state/year level: Descriptive statistics

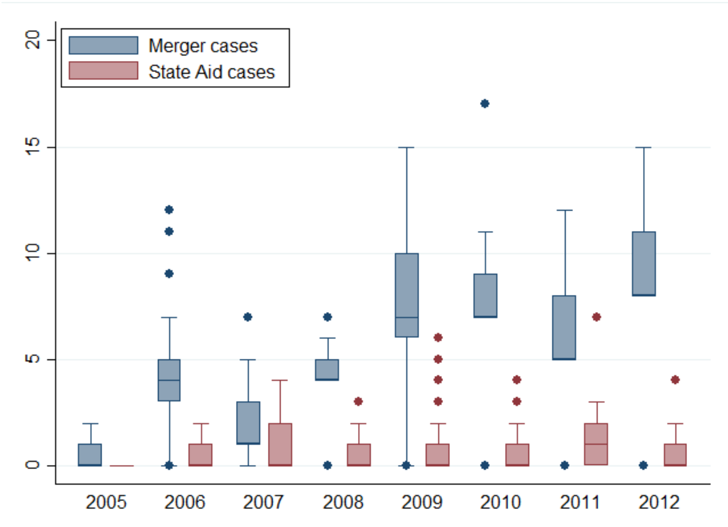
Variable	Mean	St. Dev.
Mergers		
Cases	5.12	3.73
Interventions	0.50	0.74
State aid		
Cases	0.81	1.40
Interventions	0.05	0.19
Antitrust		
Abuse & cartel cases/interventions	0.46	0.76

DIW's analysis of European Commission data on competition cases

To more precisely illustrate the data, we use box- and whisker plots to show the evolution of the entire distribution of the chosen measures over time.[25] Figure 5.2 focuses on the number of merger and state aid cases. These variables will be used as control variables to capture the level of activity in the area of mergers and state aid that could have a per se impact on competitive outcomes (see Clougherty and Seldeslachts, 2013, for a detailed rationale).

While there is a substantial number of merger cases (with an increasing trend in the first half of the sample), there are not many state aid cases.

Figure 5.2 EU competition cases



DIW's analysis of European Commission data on competition cases

In the case of mergers and state aid, the measures of enforcement intensity used in the regressions are then defined as the ratio between the number of interventions and the number of (notified) cases (see e.g., Clougherty and Seldeslachts, 2013, for a detailed rationale). In the case of abuses and cartels, all investigations led to remedies or fines. Therefore, their absolute number is used as enforcement variable.

25 These graphs represent the entire distribution of the depicted variables. Within the solid blocks, the first and third quartiles of the distribution are represented, the line in between representing the median. The lines extending vertically from the boxes (the so called 'whiskers') indicate the upper and lower adjacent values (the most extreme values within 1.5 inter quartile range of the nearer quartile). The dots represent outliers.

Most relevant to this analysis are the measures of competition policy enforcement (i.e., the ratio between merger interventions to mergers notified, the ratio between state aid schemes investigated and notified, and the absolute number of cartels and abuse cases).

Figure 5.3 illustrates the intervention of the European Commission in a sizeable fraction of cases opened in energy mergers, but there appears to be a negative time trend. Despite increasing merger notifications, there were no remedies in 2010 and 2012, and little enforcement in 2011.

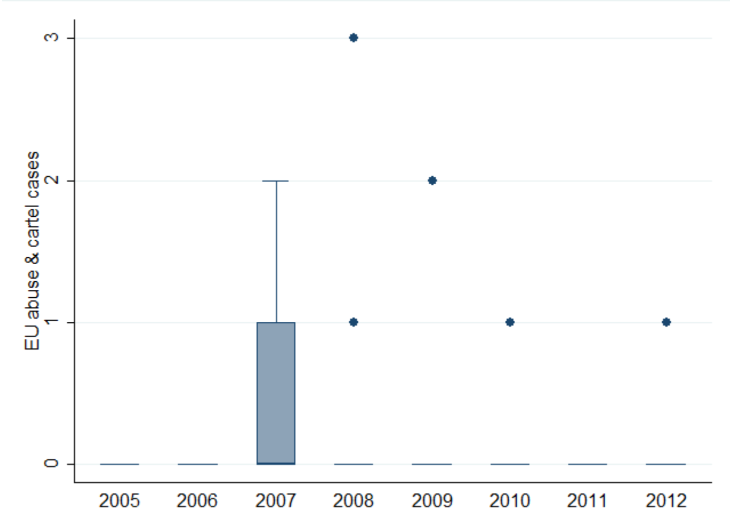
Figure 5.3 EU key merger decisions

DIW's analysis of European Commission data on competition cases

Figure 5.4 EU state aid enforcement

DIW's analysis of European Commission data on competition cases

Figure 5.5 EU abuse and cartel cases (=enforcement)



DIW's analysis of European Commission data on competition cases

State aid programs are only rarely investigated (see Figure 5.4). Similarly, only few cartels and abuse cases were opened during the sample period (see Figure 5.5). The limited variability in the data is an important limitation for the econometric analysis, as it will make the empirical identification of a relationship between competition policy enforcement and outcome variables more difficult. We come back to this point when we discuss the results.

5.1.1.2 *National competition policy enforcement data*

Constructing measures of national competition policy enforcement was challenging. Since no clear source of data is available, we created a template/questionnaire, which was sent to all national competition authorities in the EU.[26] Based on this, we constructed measures of national competition policy enforcement in a similar fashion as for the EU, where there are no state aid cases at the national level.[27] Table 5.2.shows the descriptive statistics for these variables.

Table 5.2 National competition policy enforcement at the member state/year level – Descriptive statistics

Variable	Mean	St. Dev.
Mergers		
Cases	4.63	9.48
Interventions	0.11	0.47
Antitrust		
Cartel and abuse cases/interventions	1.35	3.26
Fines (million Euro)	2.99	21.38

DIW's analysis of data on national competition cases

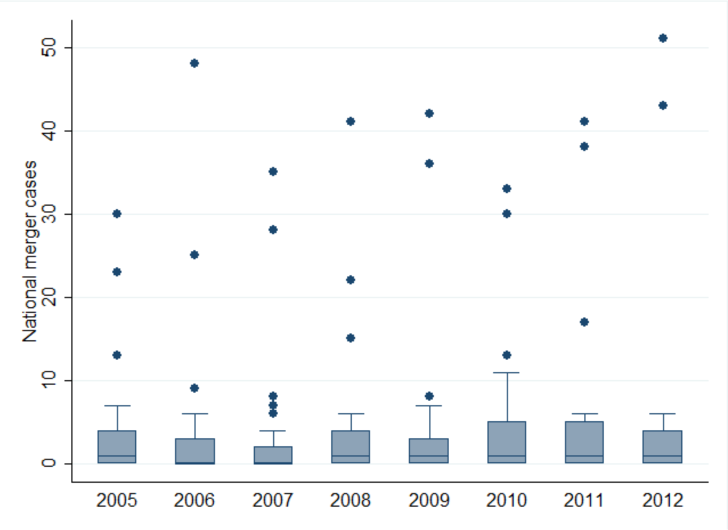
The dynamics of national competition cases and policy enforcement variables are then considered, and represented again through box and whiskers plots. There is some variation in

[26] We gratefully acknowledge the substantial support we had in this data collection exercise through DG Competition, the European Competition Network, and the National Competition Authorities. Without their help it would have not been possible to create this dataset.

[27] While we collected information separately for the electricity and gas sectors and, for each of them, for wholesale and retail markets, the very limited variability forced us to aggregate these figures at the national energy market level.

merger notifications at country level (Figure 5.6): while some large Member States (particularly Germany and Italy) average more than 30 energy mergers per year, some smaller Member States have very little activity or none at all. This is true for cartels and dominance cases, where Germany and Poland show most activity.

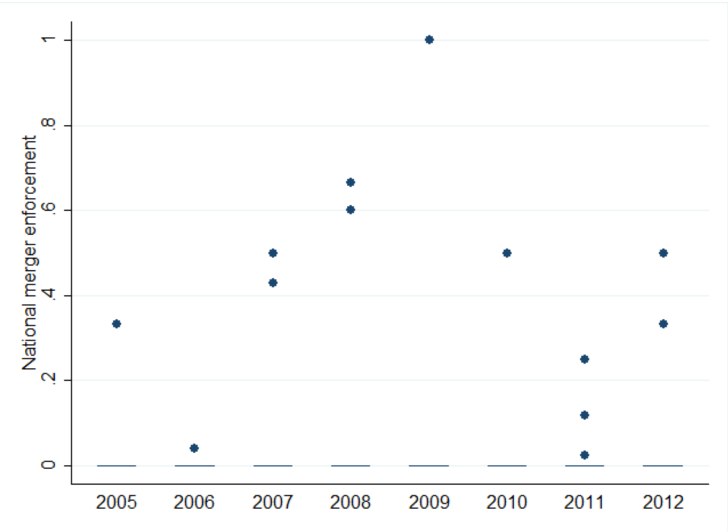
Figure 5.6 National merger cases



DIW's analysis of data on national competition cases

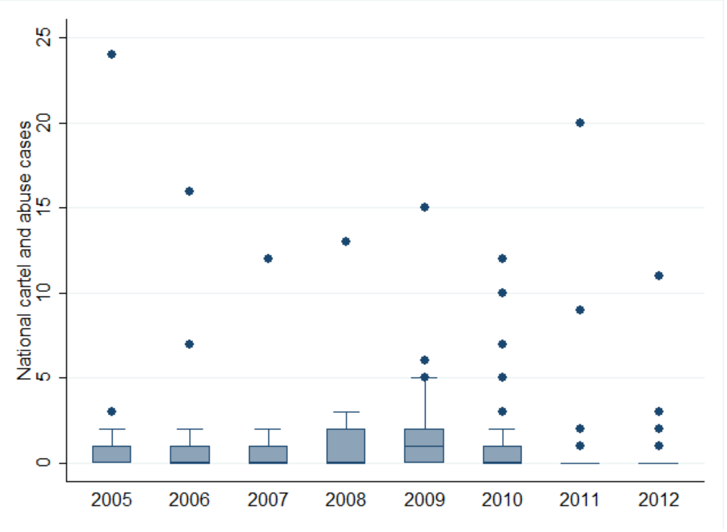
Even though national competition policy enforcement is low on average (the Member State/year observations are zero up to the 75th percentile), there is some variation across countries and time (see Figure 5.7 and Figure 5.8).

Figure 5.7 National merger policy decisions



DIW's analysis of data on national competition cases

Figure 5.8 National cartel and abuse cases (=enforcement)



DIW's analysis of data on national competition cases

5.1.1.3 Regulation

Regulation is the additional policy dimension in this framework. The OECD Indicators of Product Market Regulation project, specifically the indicators of regulation in energy, transport and communication (ETCR), described in Section 4, and were used as measures of intensity of regulation. This is the most comprehensive, accurate, and widely used database to measure the effect of regulation on market outcomes (E.g., Alesina et al. (2005); Duso and Seldeslachts (2011); and Bourles et al. (2013)).

Due to the limited variation in the data and to simplify the interpretation of the results, we use an aggregated version of these eight indexes that represent the median intensity of regulation in national energy markets in our econometric analysis.[28]

5.1.2 Outcome variables

In line with this framework, we focus on three different measures: intensity of competition, investment and productivity-based measures. The choice of the specific outcome variables implicitly also defines the analysis' level of aggregation. Some variables, such as investment and productivity growth, can be defined at the most disaggregated *firm-country-year* level, while others, such as the degree of competition, are instead naturally defined at the *sector-country-year* level. The database and exact indicators are described below.

5.1.2.1 The Amadeus database

Firm-level data was obtained from the Bureau van Dijk's Amadeus/Osiris database. The database covers 1997-2014, but since data availability thins out considerably for the earlier and latest periods, we focus on 2005-2012. We focus on firms active in energy markets as represented by the NACE group D.35. The firms in the sample fall in the subgroups D35.1 (Electric power generation, transmission and distribution) and D35.2 (Manufacture of gas; distribution of gaseous fuels through mains).[29]

We analyse those firms classified by Amadeus as 'very large', to focus on the sizeable players in the market.[30] Only these firms are expected to engage in significant investment

[28] As a robustness check, we also separately estimated all our models with the eight indicators instead of the average regulation index. All main results on the effects of competition policy enforcement are not affected.

[29] The few firms active in NACE D35.3 (Steam and air conditioning supply) were dropped from the sample.

[30] Amadeus contains information on more than 80,000 European firms indicated to be active in the energy sector, most of which are very small. The 25th percentile/median/75th percentile of employees of firms are 1/2/6, with a median total assets of just €600,000. Companies in Amadeus are considered to be very large

activities and to (strongly) react to changes in the regulatory and competitive environment. The chosen firms have a median of 117 employees and median fixed assets of around €130m.

For these firms, we collected information on relevant variables such as total assets, fixed assets, revenue, cost of labour, and material expenditures, used to build the main measures of interest as discussed below.[31] Table 5.3 reports preliminary statistics including the yearly number of firms in the database and the yearly means of the selected variables (all values are in million Euros and are PPI-adjusted using a country-year specific producer price index collected from the OECD).

Table 5.3 Mean values of Amadeus variables (all in PPI-adjusted, million €)

Year	Firms	Revenue (VA)	Total Assets (K)	Fixed Assets (FA)	Labour Cost (L)	Material Expend. (M)
2005	902	773.65	1,264.16	882.26	62.79	546.35
2006	1021	836.32	1,191.54	828.88	60.87	640.76
2007	1149	785.81	1,251.79	870.37	56.80	565.18
2008	1244	761.64	1,175.59	809.13	45.07	578.53
2009	1325	775.21	1,343.40	977.50	52.11	556.99
2010	1344	783.10	1,355.57	970.77	49.27	553.84
2011	1365	775.34	1,256.22	898.21	42.01	564.84
2012	1329	791.48	1,282.31	922.60	41.96	579.20

Source: Amadeus/Osiris database

Over the entire sample period, we observe 1,438 different firms operating in 19 countries.[32] Unfortunately, some of the variables are missing for some of the firms over time. In the various regressions we therefore have different numbers of observations depending on how demanding the data requirements are.[33]

5.1.2.2 Outcomes

We discuss here the different outcome variables, their relevance to our analysis and how they are measured via the Amadeus database.

when they have: operating revenue larger than €100m, or total assets larger than €200m, or more than 1,000 employees.

31 Total assets represent the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets. Fixed assets represent total assets excluding current assets which represent cash and other assets that are reasonably expected to be realized in cash, sold or consumed within one year or one operating cycle. Operating revenues is turnover. Labour costs represent the cost of staff.

32 The sample contains 19 member states: Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom. The most prominent countries in the sample are Germany, Spain and France with shares of 20%, 16% and 14% of total observations, respectively. Cyprus, Luxembourg and Malta are missing from the sample, because there is no firm level data for energy companies in these countries. Bulgaria, Croatia, Latvia, Lithuania and Romania had to be dropped, because OECD product market regulation data is unavailable. Austria is missing from the sample because the national competition authority was unable to supply us with data on national competition policy enforcement.

33 Specifically, the labour cost and material expenditures are the variables most likely to be missing and therefore reduce the sample on which we can estimate productivity measures.

5.1.2.2.1 Measures of the intensity of competition

Measures of the intensity of competition are naturally defined at the market-level. Well-defined product markets were desirable, but not possible for this study. The NACE codes discussed above represent the best alternative to define relevant sectors and are available for each firm in our sample. The measures of the intensity of competition used are calculated at different levels of aggregation of NACE codes.

The elasticity of relative profits with respect to relative costs

We calculate the Boone indicator – as described in Section 4, it is a measure of competition calculated as the elasticity of relative profits with respect to relative costs. Our calculations are explained below.

A structural measure to capture an industry's competitiveness: Boone's (2008) Beta

This indicator is based on the idea that when a market is more competitive, then firms that have relatively lower costs can earn relatively higher profits in this industry. In particular, Boone (2008) shows that for three efficiency levels $n_1 > n_2 > n_3$ and a level of competition intensity θ, it is the case that

$$\frac{d\left(\frac{\pi(n_1,\theta)-\pi(n_3,\theta)}{\pi(n_2,\theta)-\pi(n_3,\theta)}\right)}{d\theta} > 0,$$

where $\pi(n_i, \theta)$ are a firm's *i* variable profits. Thus, relative variable profit differences are increasing in the intensity of competition, θ.

This measure of competition is particularly useful in markets that are subject to intense reallocation dynamics, which entail significant changes in market shares, since it is monotonic with respect to the direction of the competition shock —i.e., it increases (decreases) with higher (lower) competition arising from lower entry barriers, as well as from reallocation of output to more efficient incumbent firms within the sector. One further key advantage of this measure is that it holds for any subset of firms within one market.[34] This makes it a very attractive for empirical purposes, as firm level data are often only available for a sub-sample of the firms that are active (e.g., Altomonte et al, 2010).

The degree of competitive pressure is empirically measured via the relation of the firms' profits (relative to other firms in the industry) to their (relative) cost, which we estimate based on Amadeus data. The relative profit difference (RPD) for firm *i*, in sector *s*, in country *c*, in time *t* is then defined as:

$$RPD_{isct} = \frac{\pi_{max,sct} - \pi_{min,sct}}{\pi_{isct} - \pi_{min,sct}}, \quad (1)$$

where $\pi_{max,sct}$ is defined as the profit rate (profits over revenue) of the most profitable firm in the sector *s* of country *c* and year *t*, $\pi_{min,sct}$ is defined as the profits of the least profitable

[34] Markups are often used as a measure of competition. However, conceptually, markups have problems to pick up consistently the following two ways in which competition can be intensified in a market: (i) having more firms in a market due to a fall in entry barriers and (ii) a more aggressive conduct by incumbent firms. In the former case, more firms in the market reduce markups in standard models. In the latter case markups can go up in response to an increase in competition intensity, incorrectly suggesting that competition went down (Amir, 2002, Bulow and Klemperer, 1999, Rosentahl, 1980, and Stiglitz, 1989). Boone's measure does not suffer from these problems.

firm in the same sector, country, and year and π_{isct} is defined as the profits of the focal firm.[35] In similar fashion, the firms' relative cost efficiency (RCE) is calculated as

$$RCE_{isct} = \frac{c_{max,sct} - c_{min,sct}}{c_{isct} - c_{min,sct}}, \tag{2}$$

where c represent the cost rate (total costs over revenue) of the most profitable firm in the sector *s* of country *c* and year *t.*[36]

Since competition in most energy sectors is still mainly occurring at the national level we need to estimate the relationship between relative profits and relative costs at this level of observation. Furthermore, in order not to rely on a too small number of observations to identify the parameter of interest, we further aggregate data from the electricity and gas sectors.[37] Hence, we estimate the equation using three sectors, namely production (of electricity and gas), transmission and distribution (of electricity and gas), and trade (of electricity and gas).

Specifically, we run a pooled regression where we regress the log of RPD on the log of RCE and identify separate coefficients for each aggregated sector, country, and year:

$$lnRPD_{isct} = \alpha + \beta_{sct} lnRCE_{isct} + \varepsilon_{isct}. \tag{3}$$

The resulting coefficients (the betas) —which represent the elasticity of the relative profits to respect to the relative costs— are an indication of the intensity of competition in that particular country, year and industry. In particular, the more negative the beta, the more firms are being 'punished' for being inefficient. Thus, if a policy serves to increase competition, this would result in a lower beta.

Productivity dispersion

As an additional measure of the intensity of competition at the country-sector level, calculated productivity dispersion, as the standard deviation of total factor productivity (TFP) for each country, sector and year (the following sub-section describes how we estimated TFP). The results are presented in Section 4.

Given that we estimate productivity at the more detailed four-digit NACE level, we could also define productivity dispersion at this level of observation. Yet, we re-estimate productivity measures and define productivity dispersion at a more aggregated level. Namely, we use the same level of aggregation used to define our other measure of competition -production (electricity and gas), transmission and distribution (electricity and gas), and trade (electricity and gas) - to provide comparable results across the two measures.

Our main regressions are based on this second definition. However, all key results are also obtained by using the more disaggregated definition based on more detailed four-digit NACE levels. Furthermore, for some countries we did not observe enough firms within each relevant market to obtain reasonable estimates of the TFP and, hence, reasonable values for the dispersion measure. As already mentioned in section 4, productivity dispersion could not therefore, be calculated for Cyprus, Greece, Lithuania, Luxembourg and Malta and only partially available for Croatia, Denmark, Estonia, Ireland and Latvia.

As a robustness check, we also used an alternative measure of investment calculated at the (sector)-country level. We collected publicly available information on generation capacity in electricity markets as published in the Country fact sheet by DG Energy that measure energy production capacities from combustible fuels, nuclear fuels and renewable fuels separately. See the appendix for details

35 As a measure of profit we use the variable 'profit and loss', while as a measure of revenue we use the variable 'operating revenues' from Amadeus (e.g., Altomonte et al., 2005).

36 As a measure of cost we use the variable 'Cost of goods sold' from Amadeus (Altomonte et al., 2005).

37 Indeed for several countries, we would have just a couple of observations for each disaggregated sector and year, which would produce unreliable estimates for the coefficient of interest.

5.1.2.3 Market outcome measures

Here we discuss the different market outcome variables, why they are relevant for our analysis and how they are measured by means of the Amadeus data discussed above.

Investment

We follow Grajek and Röller (2005) who use monetary measures of investment defined as the change in fixed assets owned by the firms. This variable is not a perfect measure, but it is a good first indicator of investment. The main advantage of using a monetary measure of investment is that fixed assets are observable for all firms present in the different sectors of energy markets and can be easily compared. On the downside, we cannot precisely identify the type of investment carried out by the firms. Specifically, we calculate the investment (*I*) of firm *i* in year *t* as the yearly change in firm-specific fixed assets:

$$I_{it} = FA_{it} - FA_{it-1} \tag{4}$$

The resulting variable has a mean of €18 million, with the 25th and 75th percentile lying at -7 and €11 million, respectively.[38]

Total Factor Productivity

At the firm level, we estimate the level of total factor productivity (TFP) as the residual from an industry-specific, firm-level translog production function where output is related to inputs —specifically labour, capital and material.[39] More formally, we calculate total factor productivity of firm *i* in year *t* as the residual of a sector-specific (*s*), translog production function:

$$TFP_{it} = lnVA_{it} - f_s(lnK_{it}, ln\, L_{it}, ln\, M_{it}) \tag{5}$$

where VA_{it} is the value added of firm *i* in year *t*, K_{it}, L_{it}, and M_{it} represent its capital (as measure by total assets), labour (as measured by staff costs) and material expenditures respectively. We refer to the appendix for exact estimation details. We use the TFP levels as one main outcome variable in our regressions.[40]

Table 1.1 and Figure 5.9 present the yearly summary statistics and the time evolution, respectively, for the two main firm-level outcome variables: Investment and TFP. As illustrated, investment follows a cyclical pattern with negative average investment in two years (2008 and 2011). The TFP values are calculated from parameters estimated to minimise the squared prediction errors of the model; thus, their overall mean is (very close to) zero by construction. The yearly averages therefore indicate, to which degree the firms over- or underperformed relative to the model predictions in that particular year.

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38 As a robustness check, we also used an alternative measure of investment calculated at the (sector)-country level. We collected publicly available information on generation capacity in electricity markets as published in the Country fact sheet by DG Energy that measure energy production capacities from combustible fuels, nuclear fuels and renewable fuels separately. See the appendix for details.

39 The production function is estimated in sub-samples at the sector level as defined by NACE codes (electricity generation, electricity distribution and transmission, electricity trade, gas generation, gas transmission, gas trade).

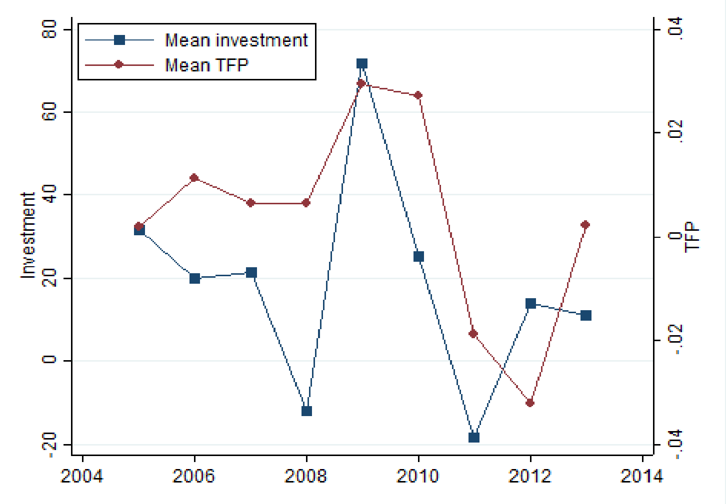
40 Using previous estimates as a dependent variable in a second stage regression introduces an additional error to the model. Consider the equation of interest $y = \alpha + \beta X + \varepsilon$. Assume that we do not observe y but have to rely on estimates of y given by $\hat{y} = y + u$. Thus, we are effectively estimating the model $\hat{y} = \alpha + \beta X + \varepsilon + u$, meaning that the variances of both ε and u enter the variance-covariance matrix (e.g., Hausman, 2001). Thus, a dependent variable obtained from prior estimations is equivalent to a dependent variable observed with measurement error, i.e. the uncertainty introduced by the first stage model makes the dependent variable noisy. Under the assumption that this error is not correlated with regressors X in the model of interest, this inflates the estimated standard errors but does not bias the resulting coefficients' estimates.

Table 5.4 Firm-level outcome variables over time

Year	Investment		TFP	
	Mean	St.Dev.	Mean	St.Dev.
2005	30.81	352.92	0.00	0.21
2006	12.77	307.58	0.01	0.20
2007	13.39	255.07	-0.00	0.23
2008	-9.27	265.22	0.01	0.22
2009	78.19	351.87	0.03	0.21
2010	15.65	306.76	0.03	0.21
2011	-24.07	217.70	-0.02	0.22
2012	7.10	224.98	-0.03	0.24
2013	47.30	437.28	-0.00	0.22

Source: Own calculation based on the Amadeus/Osiris database

Figure 5.9 Time evolution of investment and total factor productivity



Source: Own calculations based on the Amadeus/Osiris database

5.1.3 Other control variables

We use several additional sources to construct possible control variables. To account for differing institutional qualities across EU member states, we use data sourced from the World Bank (GDP per capita, population growth, energy imports as a share of total energy consumption). Information on the energy mix (i.e. the share of different fuels in energy production) used in different countries are obtained from DG energy's fact sheets.

5.2 The model specification

Our econometric framework builds on recent empirical literature analysing the link between policy enforcement and market outcomes; specifically, on the impact of regulation on investment (e.g., Alesina et al. (2005), Lyon und Mayo (2005), Grajek and Röller (2005), Cambini und Rondi (2010) as well as the relationship between competition enhancing policies and productivity (e.g., Aghion et al. (2009); Buccirossi et al. (2013); Bourles et al. (2013)). Given that we use different dependent variables (as well as levels of aggregation), the specific models differ slightly.

5.2.1 The basic framework

5.2.1.1 *Country-sector specific outcomes: The effect of policy enforcement on competition*

To summarise, according to the framework presented, we postulate that there is a direct impact of policy enforcement on the level of competition. Since measures of competition are naturally defined at the market-level, we conduct our first analysis at this level of aggregation: country-sector-year. Hence, in the basic equation we estimate variables measuring policy enforcement on the chosen outcome variable, i.e., the two measures of competition, after controlling for other observable shifters.[41] The specific functional form that constitutes our basic specification is the following:

$$Y_{sct} = \beta Reg_{ct-1} + \gamma_j EUEnf_{tool_{ct-1}} + \delta_j NatEnf_{tool_{ct-1}} + \sigma SI_t + Z_{ct-1} + \omega_{sc} + \omega_t + \varepsilon_{sct}, \quad (6)$$

where Y_{sct} is the outcome in sector *s*, in country *c*, at time *t (Boone's Beta or productivity dispersion)*. The variable Reg_{ct-1} denotes the intensity of regulation in a given national market *c* in year *t-1*, measured by using the means of the OECD regulation index for the energy sector. The variables ($EUEnf_{tool_{ct-1}}$ and $NatEnf_{tool_{ct-1}}$) are the lags of the above explained measures of competition policy enforcement at the EU and national level respectively,[42] covering different policy areas (mergers, abuse of dominance and cartel cases and, for the EU, state aid cases).[43]

To cleanly identify the effect of enforcement, we take the number of merger cases notified to the Commission as well as the number of notified staid aid cases into account as they are of course important drivers of the level of competition. Specifically, the former measure the extent of country-specific merger waves while the latter measures the potential country-specific distortions in competitive outcomes.

We set a dummy *SI* equal to one in 2007, when the EU conducted a Sector Inquiry in gas and electricity markets to assess the state of competition. This should capture the effect of this EU-wide event on competition outcomes. With this simple approach we cannot separately identify the effect of the inquiry from any other major event that might have affected energy market in the same year.

We further control for time-varying country-specific (Z_{ct-1}) factors such as GDP per capita and population growth, as well as the share of imports in total energy consumption. Additionally, the same vector includes controls for country-specific existing production capacities in combustible fuels, nuclear and renewable energy.[44] Finally, we control for unobserved time-invariant country-sector specific heterogeneity by means of country-sector fixed-effects (ω_{sc}) as well as unobserved firm-invariant time-specific aggregate heterogeneity by means of year fixed-effects (ω_t). The error term ε_{sct} is assumed to be correlated among

[41] The exact sample that we use for estimation depends on data availability with the principal constraint being missing data values in the Amadeus database.

[42] One could in principle investigate different lag structures as well, as the impact from competition policy enforcement on market outcomes could in principle last longer than just one year. Unfortunately, when adding more years to the equation, the estimation suffers from multi-collinearity issues. This has as a consequence that these additional variables are dropped and results stay the same. Therefore, while an interesting issue, the current dataset is not suited to investigate how long these effects last. The same holds for our other outcomes variables (investment and productivity) as well.

[43] As discussed in the data section for each policy action taken by the EU, we allocated the enforcement to the country (countries) which was (were) affected by that particular decision so that EU policy enforcement asymmetrically affects member states. We chose to aggregate the policy variables at the country-level rather than at the sector-country level for two main reasons. First and more importantly, we believe that policy enforcement in a specific product market has important indirect effect that spill-over into other markets. This might be due to deterrence effects (e.g., Buccirossi et al., 2013) or to the fact that different sectors in energy markets are strictly interrelated through the vertical chain. The second reason is more pragmatic and it is due to the limited variability in the data. As discussed in the data section, only the enforcement of merger control presents substantial variability at the country-level. If we were to further disaggregate this variable at the country-sector level, we would have too many observations with no variation over the entire sample period, which would make an empirical identification impossible.

[44] See the appendix for a description of the data on capacities.

observations within the same country-sector.[45] All explanatory variables are lagged by one period to reduce endogeneity issues due to simultaneity bias. The problem of identification is further discussed in the following subsection.

5.2.1.2 Firms-specific outcomes: the effect of policy enforcement on outcomes

The second level of analysis focuses on market outcomes such as investment and productivity. In our framework, we suggest that policy enforcement affects firms' outcomes in a given market through their impact on competition. Enforcement can also indirectly affect outcomes through spill-overs and deterrence, creating an indirect link between enforcement in one specific market and long-term outcomes in others. Therefore, following recent literature (e.g., Pavnick (2003); Buccirossi et al. (2013); Bourles et al. (2013)), we identify the effect of policy on outcomes by looking at the relationship between country-specific measures of enforcement and firm-specific outcomes. Our estimated model is represented by the following equation:

$$Y_{ict} = \beta Reg_{ct-1} + \gamma_j EUEnf\_tool_{ct-1} + \delta_j NatEnf\_tool_{ct-1} + \sigma SI_t + Z_{ct-1} + \omega_i + \omega_t + \varepsilon_{ict}, \qquad (7)$$

Y_{ict} is now the outcome to explain —investment or total factor productivity— of firm *i* in country *c*, at time *t*. The explanatory variables are the same as discussed above. The difference is that we now control for unobserved time-invariant firm rather than country-sector specific heterogeneity by means of firm fixed-effects (ω_{ic}). The error terms are again clustered at the country-sector level.

Depending on the chosen outcome variable, we slightly modify the above model. When we use productivity measures, we augment the model to account for the distance to the technological frontier (e.g., Aghion et al. (2009)). We therefore add the productivity of the leader firm(s) in the specific industry and year as an additional control variable to our basic regression, defined as the 90th percentile of firm-level productivities in that particular sector and year.

5.2.1.3 The Interactions between EU competition policy, national competition policy and regulation

One of the questions of this study is to determine how far regulation and competition policy enforcement interact, both at national and EU level. The framework presented above allows us to do this. Therefore, we separately analyse the effect of competition policy in the sub-samples of high- vs. low- regulated countries/periods.

These sub-samples are defined by using the median of all regulation indices for each Member State and year as reported by the OECD. We then assign sectors and firms to the high-regulation sub-sample if the value of the regulation index in that country and year is higher than the median of the OECD regulation index over all countries and time periods in our sample.[46]

Conversely, a country is low-regulated if the index takes a value lower than the median. In this way, we use not only the cross-sectional but also the time variation in the measures of regulation as countries can move from one to the other sub-sample over time by implementing major deregulatory reforms.

We choose to use sub-samples based on this dichotomous definition of high- vs. low-regulation rather than interactions between competition policy enforcement and the continuous regulatory indexes to better exploit the limited variation in the data. While the second option would allow a precise fine-tuning of the interaction effects, it might fail to deliver clear cut results due to the too scarce time-series variation in both variables. The results should also be measured in terms of marginal effects making the interpretation less

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[45] We cluster the standard errors at the country level, but we run robustness checks where we use different assumptions on the correlation structure (i.e., we use time cluster or country-time specific clusters).

[46] Results are the same if we use the mean instead of the median to indicate countries as high-regulated or low-regulated.

straightforward. We therefore consider our approach to deliver more robust and easy to interpret findings.[47]

5.2.2 Identification

The identification of a causal nexus between competition policy enforcement and outcomes relies on being able to account for potential endogeneity of our key policy variables. It is important to understand the potential sources of endogeneity to develop the best strategy to effectively tackle the issue. Endogeneity might arise from omitted variable bias and from two-way causality and measurement errors.

Two-way causality is less of a concern in our case. In principle, the enforcement of competition policy in some specific cases might be also focused to solve problems of under-investment or to increase productivity, which in turn might lead to a negative correlation between enforcement and the error term in the investment or productivity equations. However, we do not examine the effect of a specific decision on the behaviour of the firms involved in the decision, but focus on how the general enforcement of competition policy tools in one particular geographical sector (Member State) affected the behaviour of all players in that market.

To reduce the potential bias resulting from two-way causality, we use lagged values of the policy variables with respect to our dependent variable. This is a standard approach that relies on the assumption that the lagged values of the policy are uncorrelated with the error terms of the estimated equation. Several other studies (e.g., Alesina et al.(2005); Buccirossi et al. (2013), Bourles, et al. (2013), Griffith et al. (2004)) use this type of exclusion restrictions to identify the causal effect of deregulation, competition policy and R&D on investment and industry TFP growth.

The main identification issue in the context of our model is related to the potential existence of an omitted variable bias. The panel structure of our data-set allows us to control for time-invariant unobserved individual heterogeneity at the firm/industry-country level through fixed-effects, and for time fixed-effects. However, there might still be time-varying unobserved heterogeneity. In particular, this might derive from the existence of other policies correlated with competition policy enforcement that might affect firms' behaviour.

In our basic specifications following the existing literature (e.g. Alesina et al. (2005) and Grajek and Röller (2011)), we control for those factors that we believe are the most prominent policies affecting competition in energy markets, namely product market regulation, liberalisation, and privatisation. We are confident that these controls help mitigate the endogeneity problem, but should stress that our results have to be interpreted as enhanced correlations rather than cleanly identified causal effects.

5.3 Results of the econometric analysis

5.3.1 Country-sector level results: the intensity of competition

We begin with the analysis of the link between competition policy enforcement and the level of competition at the country-sector level represented by equation (6). In this model, the outcome variables of interest are the country-sector Boone's betas (i.e., the elasticity of relative profits with respect to relative costs) and the country-sector standard deviation of total factor productivity (i.e., productivity dispersion).

5.3.1.1 The elasticity of relative profits with respect to relative costs: Boone's beta

The first step focuses on a measure of competition intensity that reflects the negative relationship between profits and cost efficiency, faced by firms in a competitive environment. A

[47] The low regulation countries (indexed over all years in our sample) are: Belgium, Czech Republik, Germany, Hungary, Italy, Netherlands, Portugal, Spain, Sweden, UK. High regulation countries are: Denmark, Estonia, Finland, France, Greece, Ireland, Luxembourg, Poland, Slovakia, Slovenia.

decrease in this measure can be interpreted as an increase in competition. To facilitate the comparison of the coefficients' estimates of the various explanatory variables that are measured in different units, we report standardised beta coefficients. The measured effects therefore represent the change in one standard deviation of the dependent variable due to one standard deviation change in the variable of interest.[48] See Table 4.6 for the estimated standardised coefficients.

We find a **negative and significant impact of EU key merger decisions on elasticity of relative profits with respect to relative costs in low-regulated countries**. In particular, a standard deviation increase in EU key merger decisions decreases the relative profit elasticity by 0.582 standard deviations in the sub-sample of low-regulated countries. The effect is negative but much smaller and non-significant also in the full sample and in the sub-sample of high-regulated markets.

On the contrary, almost all other measures of enforcement either at EU or national level are not significant.[49] Only the number of national cartel and abuse investigations significantly reduces the beta, and increases competition, in the sub-sample of high regulated countries. State aid schemes also have a significant positive impact on the relative profit's elasticity and significantly reduce competition: one standard deviation increase in the state aid schemes increases the beta by 0.119 standard deviations. Finally, regulation does not seem to have a statistical impact on the level of competition on average.

Table 5.5 Relative profit elasticity wrt. relative costs, full sample and low/high regulation subsamples

	Full sample		Low Regulation		High Regulation	
	Coeff.	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
EU merger decisions (lagged)	-0.290	(-1.51)	-0.582***	(-9.37)	-0.124	(-1.07)
EU State aid enforcement (lagged)	0.003	(0.11)	-0.010	(-0.28)	0.004	(0.06)
EU abuse & cartel enforcement (lagged)	-0.027	(-0.55)	-0.187	(-1.39)	-0.068	(-1.11)
National merger decisions (lagged)	-0.003	(-0.12)	0.035	(0.44)	0.080	(1.28)
National cartel fines (lagged)	0.040	(1.33)	0.098	(1.11)	0.018	(0.32)
National abuse & cartel enforcement (lagged)	-0.264	(-1.00)	0.253	(1.17)	-0.905**	(-2.49)
Sector Inquiry (production)	0.071	(0.80)	0.124*	(1.87)	0.109	(0.80)
Sector Inquiry (transmission)	0.137	(1.34)	0.117	(1.46)	0.219**	(2.43)
Sector Inquiry (trade)	0.133	(1.26)	0.098	(1.21)	0.202**	(2.35)
Regulation (OECD index) (lagged)	0.022	(0.04)	-0.364	(-1.06)	-0.419	(-1.47)
EU merger cases (lagged)	-0.004	(-0.03)	0.084	(0.47)	0.003	(0.01)
State aid cases (lagged)	0.006	(0.08)	-0.279	(-1.57)	0.119**	(2.44)
National merger cases (lagged)	-0.182	(-1.15)	0.126	(0.42)	-0.064	(-0.43)
GDP per capita	0.633	(0.73)	-0.350	(-0.32)	-0.876	(-0.45)
Population growth	-0.015	(-0.12)	-0.133	(-0.70)	0.220	(1.04)
Energy imports (% of tot. cons.)	0.745	(0.98)	1.039*	(2.13)	0.889	(1.67)
R-squared	0.22		0.61		0.39	
Observations	259		129		130	

[48] The standardised beta coefficients are the coefficients estimates obtained by using standardised independent variables in the regressions, i.e. by dividing the values of the variable by its respective standard deviation so that their variances are one.

[49] As we already mentioned in the data session, this is may be related to the limited variability in these explanatory variables, which makes the empirical identification of significant relationships quite challenging. Hence, we do not consider these results as confirming that enforcement measures do not affect market outcomes; the non-significant outcomes may be related to statistical issues generated by the data quality.

The level of observation is country-sector-year. The dependent variable is the sector-country specific elasticity of relative profits with respect to relative costs, Boone's beta. All policy variables are lagged one year to reduce endogeneity issues. We report standardised coefficients. Standard errors are robust and clustered at the country level. The t-statistics are reported in parentheses. We control for country-sector fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

5.3.1.2 Productivity dispersion

Table 5.6 shows the results of using productivity dispersion as a dependent variable. The main result from these regressions is the **negative and significant impact of EU key merger decisions on productivity dispersion**. A standard deviation increase in EU key merger decisions decreases TFP dispersion by 0.101 standard deviation in the full sample. This effect is significantly larger in the sub-sample of low-regulated countries, where the standardised coefficient increases to 0.177 in absolute value. The effect is much smaller in the sub-sample of high-regulated markets (-0.046). These results hint to a significant interaction between competition policy enforcement and regulation: merger control helps reduce productivity dispersion, and increases competition, only in those countries where regulation is weak.

The other measures of EU competition policy enforcement, and almost all measures of national competition policy enforcement, do not have a strong impact on TFP dispersion, with only two exceptions. National cartel and abuse enforcement decreases productivity dispersion in low-regulated markets: one standard deviation increase in cartels fines at the national level significantly decreases productivity dispersion by 0.084. Further, an increase in one standard deviation of EU abuse and cartel cases significantly increases productivity dispersion – and decreases competition - by 0.197 standard deviations in high-regulated markets. Finally, regulation does not seem to have a statistical impact on the level of competition on average.

Table 5.6 Standard deviation of TFP, full sample and low/high regulation subsamples

	Full sample		Low Regulation		High Regulation	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
EU merger decisions (lagged)	-0.101**	(-2.31)	-0.177***	(-5.41)	-0.046	(-0.25)
EU State aid enforcement (lagged)	-0.019	(-0.57)	0.028	(1.43)	-0.032	(-0.57)
EU abuse & cartel enforcement (lagged)	0.060	(0.72)	-0.040	(-0.36)	0.197**	(2.52)
National merger decisions (lagged)	-0.011	(-0.34)	0.000	(0.00)	-0.059	(-1.17)
National cartel fines (lagged)	0.002	(0.05)	-0.084*	(-1.96)	0.001	(0.02)
National abuse & cartel enforcement (lagged)	-0.085	(-0.76)	0.006	(0.07)	-0.077	(-0.46)
Sector Inquiry (production)	0.065	(0.73)	0.094	(0.72)	0.085	(0.52)
Sector Inquiry (transmission)	0.069	(1.42)	0.133	(1.44)	0.054	(0.74)
Sector Inquiry (trade)	-0.004	(-0.09)	0.042	(0.33)	-0.000	(-0.00)
Regulation (OECD index) (lagged)	0.064	(0.38)	-0.432	(-0.80)	-0.071	(-0.38)
EU merger cases (lagged)	-0.073	(-0.83)	-0.155*	(-2.07)	0.127	(0.56)
State aid cases (lagged)	0.126**	(2.52)	0.112	(1.80)	0.189**	(2.59)
National merger cases (lagged)	-0.067	(-0.50)	0.195**	(2.69)	-0.224**	(-2.89)
GDP per capita	1.356	(1.16)	0.426	(0.40)	0.940	(0.64)
Population growth	-0.222	(-1.40)	-0.631**	(-2.73)	0.071	(0.71)
Energy imports (% of tot. cons.)	0.137	(0.35)	0.246	(0.46)	0.438	(1.23)
R-squared	0.37		0.40		0.51	
Observations	319		157		162	

The level of observation is country-sector-year. The dependent variable is the country-sector-year specific standard deviation of total factor productivity. All policy variables are lagged one year to reduce endogeneity issues. We report standardised beta coefficients. Standard errors are robust and clustered at the country level.

The t-statistics are reported in parentheses. We control for country-sector fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

The control variables also produce interesting results. EU merger cases increase productivity dispersion in low-regulated markets, while national merger cases reduce it in high-regulated markets. This would imply that mergers are on average beneficial for competition, possibly by increasing efficiency. State aid schemes seem to have the opposite effect and increase productivity dispersion. This might be because subsidies reduce the exit of relatively inefficient firms and, accordingly, increase the productivity dispersion. This latter effect is predominantly found in the high-regulation sub-sample: a standard deviation increase in state aid cases increases productivity dispersion by 0.189 standard deviations.

5.3.1.3 *Firm investment*

Table 5.7 shows the results of using the estimation framework (7) to examine the impact of competition policy on investment. We estimate a **significant positive impact of the enforcement of EU merger control on firms' investment in the sub-sample of low-regulated countries**. In particular, one standard deviation increase in the ratio between merger intervention and merger notifications increases firm-level investment by 0.226 standard deviations.

Table 5.7 Investment in full sample and low/high regulation subsamples

	Full Sample		Low Regulation		High Regulation	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
EU merger decisions (lagged)	-0.007	(-0.31)	0.226***	(2.90)	-0.006	(-0.20)
EU State aid enforcement (lagged)	-0.001	(-0.07)	-	-	-0.008	(-0.38)
EU abuse & cartel enforcement (lagged)	0.020	(0.51)	-0.265***	(-2.60)	0.059**	(2.29)
National merger decisions (lagged)	0.008	(0.36)	0.002	(0.05)	0.005	(0.26)
National cartel fines (lagged)	-0.003	(-0.11)	-0.038	(-0.34)	-0.018	(-1.01)
Sector Inquiry	0.058	(1.07)	-0.059	(-0.65)	0.062	(1.23)
Regulation (OECD indicator) (lagged)	0.178	(1.67)	2.815***	(3.30)	0.153	(1.59)
EU merger notifications (lagged)	-0.037	(-1.49)	-0.378***	(-2.87)	-0.060	(-1.10)
State aid cases (lagged)	0.029	(1.55)	0.195**	(2.37)	0.024	(0.91)
National merger cases (lagged)	0.015	(0.27)	-0.210	(-0.63)	0.010	(0.12)
National cartel & abuse cases (lagged)	0.020	(0.70)	0.008	(0.08)	0.065	(1.20)
Electricity capacity (combustible)	-0.627	(-1.52)	-0.486	(-0.72)	-0.604	(-1.44)
Electricity Capacity (nuclear)	-0.448	(-1.00)	9.016***	(3.46)	4.234	(1.40)
Electricity Capacity (renewable)	0.329**	(2.54)	0.909***	(2.66)	0.223*	(1.70)
GDP per capita	-0.676**	(-2.56)	-0.577	(-1.20)	-0.621	(-1.53)
Population growth	0.088*	(1.99)	0.654***	(5.29)	0.034	(0.83)
Energy imports, % of tot cons	0.077	(0.62)	0.288	(0.86)	0.223	(1.14)
R-squared	0.17		0.18		0.21	
Observations	8,344		4,098		4,246	

The unit of observation is firm-country-year. The dependent variable is firm level investment. All policy variables are lagged one year to reduce endogeneity issues. We report standardised beta coefficients. Standard errors are robust and clustered at the country level. We control for firm fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

Few of the other competition policy enforcement variables have a significant effect on investment. Only EU cartel and abuse cases significantly increase investment in high-regulated markets while significantly decreasing it in low-regulated markets.

We further estimate a positive and significant coefficient for state aid notifications in low-regulated countries. This variable identifies the effect of the state aid programmes themselves. These programmes often aim to support companies in financial distress and might be expected to have been used to acquire additional assets and to increase investment.

We also find a significant positive effect of regulation in the sample of low-regulated markets. The results suggest that an increase of one standard deviation in the regulation indexes increases investment by 2.815 standard deviations.[50]

Among the control variables, an increase by one standard deviation of existing production capacities in renewables significantly and substantially increases investment by 0.329 standard deviations in the full sample and even more so (0.909 standard deviations) in the low regulation sample. This finding might be attributed to possible complementarities in renewable energy investments. More mergers at EU level also decrease investment in low regulation industries, which compliments the positive impact of merger remedies on investment. A higher concentration seems bad for investment.

In the appendix, we further report three different robustness checks for the investment estimations: we look at heterogeneity across sectors, we estimate autoregressive investment equations, and we use an alternative measure of investment based on capacities.

5.3.1.4 *Firm-level Total Factor Productivity (TFP)*

Next we analyse the effect of competition policy enforcement on the long-term outcome variable: the firm-level total factor productivity. We begin again with the full sample and then analyse the sub-samples of high- and low-regulated markets. The standardised beta coefficients are reported in Table 1.1.

Consistent with our previous results, **EU key merger decisions increase TFP in the sub-sample of low-regulated countries**. In particular, one standard deviation increase in the ratio of merger interventions and merger notifications increases TFP by 0.329 standard deviations. Most other policy enforcement variables are estimated to have little effect on TFP.

Among the control variables, we estimate a significant positive coefficient for the productivity level of technology leaders. This can be interpreted as the ‘catching-up’ effect to the productivity frontier. The magnitude is similar in the full sample as well as in the low-regulated markets, while it is much smaller and not significant in high-regulated markets: a standard deviation increase in the leader’s TFP increases firms’ TFP by 0.064 to 0.072 standard deviations. We estimate a negative and significant effect of regulation in the high-regulation sub-sample: regulation has a deleterious effect on productivity when it is too high.

[50] When looking at the disaggregated effect of the different components of this index (not reported) we see that the estimated effect specifically comes from higher public ownership and more concentrated market structure in gas markets.

Table 5.8 TFP levels in full sample and low/high regulation subsamples

	Full Sample		Low Regulation		High Regulation	
	Coeff.	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
Leader Productivity	0.064**	(2.61)	0.072*	(1.79)	0.046	(1.21)
EU merger decisions (lagged)	0.046	(1.73)	0.329***	(2.89)	0.061	(1.59)
EU State aid enforcement (lagged)	-0.029	(-1.55)	-	-	-0.013	(-0.44)
EU abuse & cartel enforcement (lagged)	0.011	(0.27)	-0.017	(-0.11)	-0.025	(-0.71)
National merger decisions (lagged)	0.001	(0.10)	0.058	(1.03)	0.015	(0.49)
National cartel fines (lagged)	0.003	(0.08)	0.211	(1.19)	0.003	(0.14)
Sector Inquiry	-0.023	(-0.32)	0.070	(0.50)	-0.004	(-0.07)
Regulation (OECD indicator) (lagged)	-0.067	(-0.32)	0.317	(0.26)	-0.219*	(-1.93)
EU merger cases (lagged)	-0.032	(-0.78)	0.178	(0.85)	-0.131*	(-1.76)
State aid cases (lagged)	-0.045	(-1.18)	0.003	(0.02)	-0.025	(-0.67)
National merger cases (lagged)	0.071	(0.69)	-0.611	(-1.27)	-0.098	(-0.80)
National cartel cases (lagged)	0.027	(0.61)	0.115	(0.75)	-0.000	(-0.01)
Electricity capacity (combustible)	-1.190	(-1.73)	1.815	(1.62)	-1.033*	(-1.80)
Electricity Capacity (nuclear)	0.251	(0.65)	-0.273	(-0.07)	-8.628**	(-2.02)
Electricity Capacity (renewable)	0.376	(1.30)	0.086	(0.17)	0.511***	(2.67)
GDP per capita	-0.411	(-0.81)	-0.720	(-0.99)	-0.381	(-0.68)
Population growth	0.001	(0.01)	0.210	(1.11)	0.064	(1.11)
Energy imports, % of tot cons	-0.415	(-1.64)	1.527***	(-3.05)	0.528*	(1.79)
Adjusted R-squared	0.25		0.22		0.33	
Observations	4,225		2,143		2,082	

The unit of observation is firm-country-year. The dependent variable is firm level total factor productivity. All policy variables are lagged one year to reduce endogeneity issues. We report standardised beta coefficients. Standard errors are robust and clustered at the country level. We control for firm fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

Annex 3 contains a robustness check for the TFP estimations, examining heterogeneity across sectors.

5.4 Conclusions

This chapter focuses on identifying the broad effects of competition policy enforcement on the functioning of EU energy sectors and its interactions with regulation. The evidence paints a broad picture of the different channels through which policy affects outcomes. Specifically, the impact of competition policy on measures of competition - the elasticity of relative profits with respect to relative costs (Boone indicator) and productivity dispersion - and the effect of policy enforcement on outcomes, such as investment and, ultimately, productivity.

Our framework captures both direct and indirect effects of the policies, because it examines broad national energy sectors, capturing both the impact of policy decisions on the firms involved, and on other firms in the same market, plus potential spill-overs and deterrence effects in other (national) markets.

One overall picture emerges. EU merger policy enforcement is consistently and significantly related to better outcomes, particularly in low-regulated sectors. First, EU key merger decisions lower both Boone's indicator and productivity dispersion, indicating that national energy sectors became more competitive after these interventions. A more active EU merger control is also related to higher investment and higher total factor productivity. This is consistent with the reasoning that EU merger policy actions - through the channel of competition - encourage energy firms to invest more, ultimately generating higher productivity.[51]

These results are strongest in low-regulated sectors, which reinforces previous studies that show competition policy is mostly effective where the competitive process is not influenced by high regulation (e.g., Buccirossi et al. (2013)). A potential mechanism at play could be that if firms are highly regulated, changing the way competition works through competition policy has little impact. For example, if investment is regulated then a different market structure will not change investment. If it is not, a different market structure may induce different behaviour from market participants.

Bergman et al. (1998) further argue that once an industry has reached a particular threshold of deregulation, competition should be introduced and safeguarded through competition policy. According to this logic, regulation and competition are substitutes. Competition policy's role and impact should therefore be higher in low-regulated industries.[52] As regulation is reduced over time, competition should be gradually introduced. Competition policy should also be strengthened to preserve competition. It would be interesting to further explore Time dimension.

There are two important caveats. First, other policy enforcement measures show a more patchy impact, i.e. they show a more limited correlation pattern with market outcomes. But this does not conclusively prove lack of effectiveness. It is possible that their low frequency of occurrence prevented us from empirically identifying consistent relationships. Second, causal inferences are important While we tried to deal with issues such as reverse causality bias (by lagging the policy variables) and omitted variable bias (by using fixed effects and other controls), our identification strategy is not based on a clear source of exogenous variation since it is virtually impossible to find exogenous variation in such a broad and heterogeneous framework.

Therefore, we cautiously interpret our results as illustrating strong correlations between EU merger policy enforcement and market outcomes rather than truly causal links. But the conceptual framework behind our empirical analysis (policy enforcement affects competition, which then affects firms' investment behaviour. Changes in the intensity of competition and firms' investment behaviour generate changes in productivity) suggests a plausible causal link between completion policy enforcement and productivity.

51 The reasoning goes as follows: if competition policy authorities perform a good job, then among the mergers that go through are several where efficiency gains dominate. Consequently, merger policy actions are associated with better market outcomes. Additionally, if key merger decisions involve deterrence, their beneficial impact should be substantially higher.

52 One might also make the argument that the impact of competition policy interventions could sometimes be stronger in highly regulated markets, and thus one would observe complementarities between both sometimes. For example, in countries where companies are vertically integrated or monopolised, anti-trust interventions to avoid market foreclosure and abuse of dominance would be important.

6 Case study: E.ON's alleged abuse of dominant position in the German wholesale electricity market

This case study demonstrates the direct effects of a specific decision on the market under consideration and the short-term impact of that decision on competition and, specifically, on prices. Because the intervention directly affected the wholesale electricity market, the analysis begins with the decision's effect on wholesale prices, because the suitability of the remedies to address the competitive concerns can only be assessed at this level.

It also looks at the effect of the decision on downstream retail electricity prices to carefully measure the overall impact of an alleged misconduct upstream in vertically related markets, This should not be considered a direct evaluation of the Commission's decision, but it does enable conclusions on the extent of the pass-through of the reduction of wholesale electricity prices on retail prices. This pass-through mainly results from the conditions of competition on the retail electricity market.

6.1 Introduction to the case

In 2008, the European Commission investigated claims about E.ON withdrawing available generation capacity from the German wholesale electricity market to raise prices and deter new investors. The investigation confirmed the presence of competition concerns. Consequently, E.ON agreed to divest a total of 5,000 MW of generation capacity and the case was settled.[53]

Figure 6.1 illustrates the location of the plants concerned, whereby the size of the circles represent the size of the divestitures. The Commission decision was announced in 2008 and the remedies implemented over subsequent years. Specifically, the various plants were sold to different buyers between January 2009 and May 2010[54].

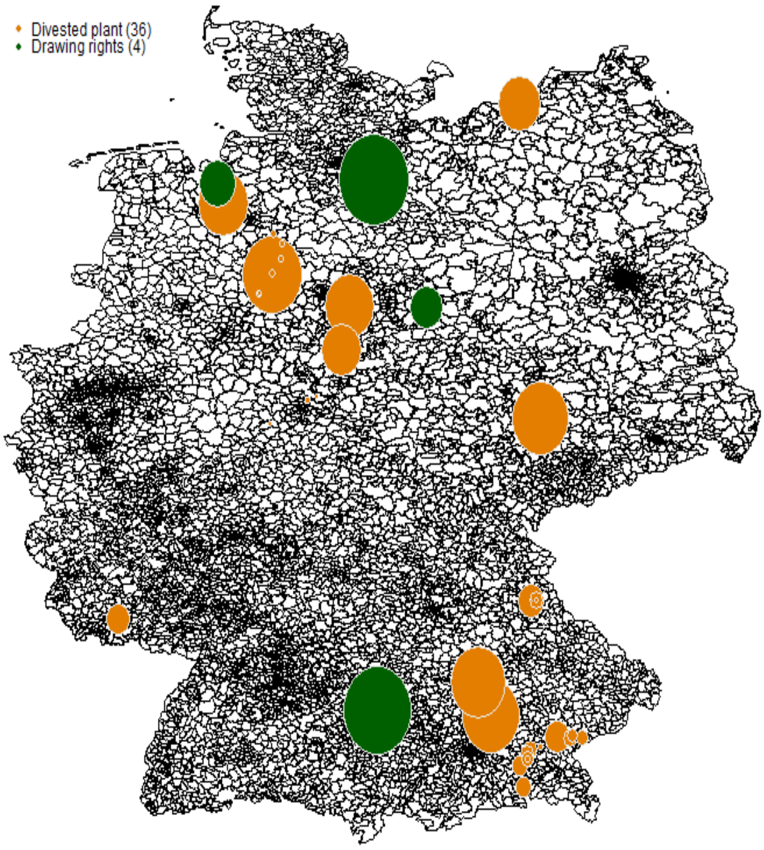
The Commission also raised concerns that E.ON may have favoured its production affiliate for providing balancing services, while passing the resulting costs on to consumers, potentially preventing other power producers from exporting balancing energy into its transmission zone. To address these concerns in the electricity balancing market, E.ON committed to divest its extra-high voltage network. The divestiture of E.ON balancing net also took place in early 2010.

Cumulatively, the Commission decision(s) affected two main product markets: the German wholesale energy market and the balancing energy market. The following concentrates on the former and includes our deliberation that the approach was reasonable.

[53] As noted by Sadowska (2011), the E.ON case has to be considered a "commitment decision". The Commission, pursuant to Article 9, did not demonstrate or confirm the existence of a dominant position or an abuse but it simply made the undertakings' commitments binding. This has important policy implications. Specifically, Sadowska (2011) discusses the advantages but also the substantial drawbacks of commitment procedure in antitrust cases.

[54] Specifically, Electrabel acquired 931 MWh capacity as well as 1,500 MWh drawing rights, EnBW acquired 781 MWh capactity as well as 159 MWh drawing rights, Statkraft, Verbund, Morgan Stanley, TenneT, and Stadtwerke Hannover acquired 753, 312, 403 415, and 345 MWh capacity, respectively.

Figure 6.1 The divestiture of capacity in the alleged E.ON abuse case



Source: Own representation based on the Commission information

Balancing markets are ancillary mechanisms key to a well-functioning energy market, because they ensure that demand is equal to supply in real time. In Germany, electricity generators are mandated to reserve a fraction of their capacity for the transmission system operators, which they can use to restore frequency and load in the electricity grid (Haucap et al. (2012)).

Wholesale electricity markets and balancing markets should be related because there exist arbitrage opportunities between the spot market and the balancing mechanism (Just and Weber, (2012)). Prices in the balancing markets (capacity prices) constitute a sort of opportunity cost for energy suppliers who commit themselves not to use the reserved capacity on wholesale spot markets. Therefore, the alleged abuse in the balancing market might be expected to have affected competition at the wholesale level.

However, empirical evidence for the German market suggests that this relationship is less strong than one would expect in theory. Just and Weber (2012) try to quantify the effect of the strategic arbitrage behaviour between the German wholesale and balancing market. They show a "*clear tendency that market participants use the arbitrage opportunity to fulfil their supply commitment with relatively cheap balancing energy when spot prices are relatively high, and vice versa. In periods with intraday spot prices above 120 €/MWh, the control zones are predominantly undersupplied. The Amprion control zone is undersupplied in 75 per cent a d the GCC control zone in 80 per cent of those 64 ¼-hours, with an average imbalance of -267 MW and -488 MW, respectively. The opposite is true for prices roughly below -20 €/MWh – with Amprion being oversupplied in 77 per cent with an average of 501 MW and GCC in 74 per cent of those 196 ¼-hours with 819 MW on average. It should be noted that imbalances did not exceed the contracted reserve capacity and that periods with extreme spot prices were not overly exploited as the incentives might suggest.*"

We conclude, therefore, that the effect of the unbundling in the balancing market could have been important in the long-run to explain the dynamics of wholesale prices, but we consider it second order if compared to the direct effect of the potential abuse in the wholesale market, particularly in the short-run. Therefore, here we focus more explicitly on trying to evaluate the first part of the decision, i.e. the alleged abuse of dominant position in the wholesale electricity market. Specifically, we try to isolate the effect of the implementation of the single capacity divestitures. But we admit that we will be unable to cleanly separate the different effects from the two parts of the decision, particularly when looking at the long-run implications.

Given that the unbundling of the extra-high voltage network was completed on January 1 2010 together with the divestiture of some of the E.ON's capacity, it is also not possible in the most disaggregated analysis trying to capture the short-term effects of the decision to separately identify the effects of the two remedies. What we will empirically measure is the cumulative effect of all remedies imposed.

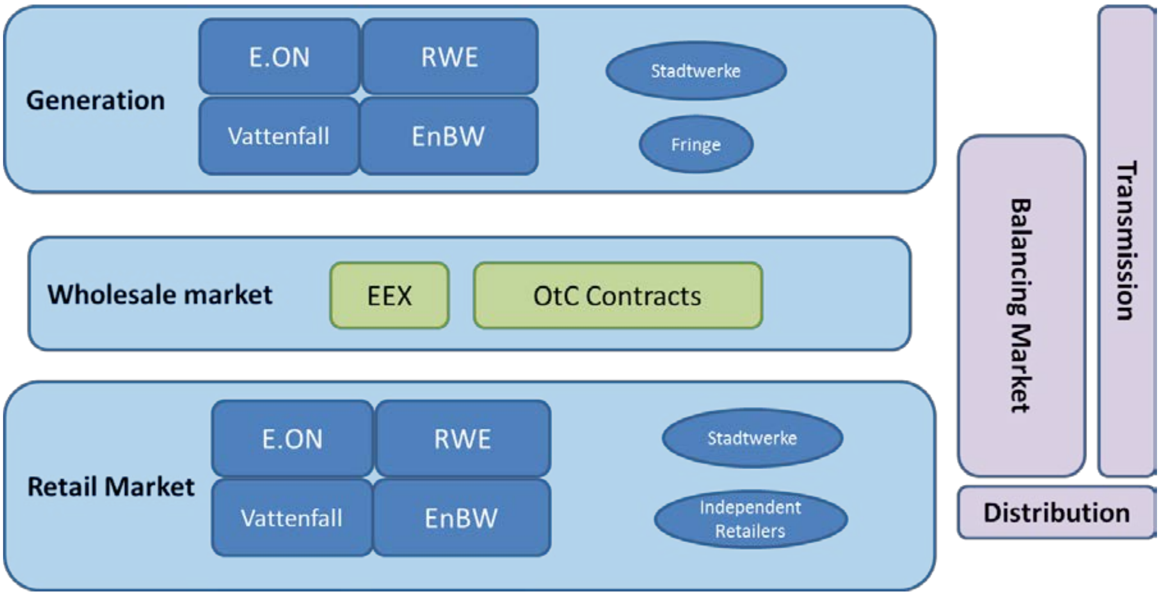
To identify the effect of the E.ON alleged abuse and the Commission's decision, we set up an empirical methodology specifically tailored to the peculiar structure of energy markets.

Three main characteristics play a crucial role both for the choice of the appropriate outcome variable of our retrospective evaluation and the identification strategy: i) the extent of market power upstream and downstream; ii) vertical integration and ownership structure and iii) long- term contracts. All these aspects are part of our empirical evaluation strategy, discussed below, beginning with a description of the complexity of the German electricity market.

6.2 The German electricity market

The German electricity sector is characterised by a vertical structure with a generation stage, a wholesale market, and retail markets (see Figure 6.2). A transmission system —extra high voltage and high voltage networks, 380 and 220 kV respectively— assures that energy generated or imported is delivered to regional supply companies, which then distribute them via low or medium voltage networks —below 20 kV and 20-110 kV respectively— to energy retailers and final customers. Finally, a parallel balancing market ensures that the needed tension is present in the network at each point in time (cfr. Case No COMP/M.4110 - E.ON / ENDESA).

Figure 6.2 The Structure of the German Electricity Market



Source: Own representation

6.2.1 Generation and wholesale market

The generation stage in Germany is dominated by four vertically integrated - though legally unbundled - big players: E.ON, RWE, Vattenfall, and Energie Baden-Württemberg (EnBW), who are also the main players in the retail market and also own a large part of the network.[55] These operators jointly produce 2/3 – 3/4 of total German electricity demand. The rest of the German energy needs are covered by the local production of a large number of municipal operators (‘Stadtwerke’) and other smaller producers, or imported from abroad.

In 2004, the European Commission (Case No COMP/M.4110 - E.ON / ENDESA pg. 10) reported that “*[b]y far the largest proportion of electricity in Germany is generated by four vertically integrated energy suppliers: E.ON, RWE, Vattenfall and EnBW. In generation (installed capacity) RWE Power is market leader, with a [30-40 per cent] market share (2004 data), followed by E.ON ([20-30 per cent]), Vattenfall ([10-20 per cent]) and EnBW ([10-20 per cent]). Other companies jointly represent [10-20per cent]”.*

This picture remained quite stable duringsubsequent years. In its “Sector Inquiry into Electricity Generation and Wholesale Markets (B10-9/09) Report” published in 2011, the German Competition authority – the Bundeskartellamt (BKartA) – reported that the German electricity market is characterised by joint dominance. The shares of net electricity of the four big players for the years 2007, 2008, and 2009 are reported in Table 6.1.

Table 6.1 Market share of the big four energy company – 2007-2009

	Generated Capacity (MW)			Total Electricity Feed-in (TW/h)		
Generator	**2007**	**2008**	**2009**	**2007**	**2008**	**2009**
RWE	34%	33%	31%	35%	36%	31%
E.ON	23%	23%	19%	23%	22%	21%
Vattenfall	17%	16%	16%	17%	15%	16%
EnBW	12%	12%	14%	12%	11%	14%
Market Volume	94,433	95,756	n.r.	467.9	465.1	n.r.

Source: Bundeskartellamt, “Sector Inquiry into Electricity Generation and Wholesale Markets (B10-9/09) Report”, 2011

The BKartA’s investigation not only looked at market shares of the alleged dominant firms but also analysed additional measures of the extent of market power in energy markets. Specifically, the BKartA calculated a firm-specific index that measured market power in the electricity first-time sales market as the size of a supplier’s available capacity in relation to the overall demand: the so-called Residual Supply Index (RSI).

Based on the result of this analysis, the BKarA stressed that possibly all four big players in the German wholesale energy markets in 2007-2008 were “*in a position to behave to an appreciable extent independently of their competitors, customers and ultimately of their consumers and to restrict competition on the first-time sales market. […] Each of these undertakings was essential for meeting Germany’s electricity demand in a considerable number of hours.*” (Bundeskartellamt, 2011, pg. 6).

The BKartA also indicated that the market power of the big four was expected to decline following the implementation of the remedies imposed by the European Commission in its antitrust investigation that required E.ON to divest generation capacity as well as a consequence of the economic crisis. However, they still expected a joint dominance in the German wholesale electricity market to continue during the following years.[56]

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[55] Since July 1st 2007, the German „Gesetz über die Elektrizitäts- und Gasversorgung – Energiewirtschafts-gesetz“ (EnWG) requires vertically integrated energy suppliers to legally unbundle from system operators previously related to them. Section 7 (2) exempts from this obligation all those vertically integrated energy suppliers serving directly or indirectly less than 100.000 customers.

[56] The BKartA’s Decision Division identified several reasons that would make uncertain whether the observed power plant operational management would be an evidence of any possible abusive capacity withholding rather than the consequence of “*objective reasons for not operating power plants whose marginal costs are lower than the day-ahead spot market price*” (Bundeskartellamt, 2011, pg. 6). As a consequence, the BKarA

For what concerns wholesale markets, most of the generated electricity is either sold internally to the retail outlets of the vertically integrated producers or sold to other retailers via bilateral, over the counter (OTC) contracts as well as through a centralised energy exchange market. Since 2002, the German wholesale energy market is, at least partially, determined through the European Energy Exchange (EEX) market located in Leipzig. Most energy trade between wholesalers and retailers in Germany is still done by means of OTC long-term bilateral contracts between producers and suppliers, with only a minor albeit increasing percentage of energy trade covered through the EEX.[57]

6.2.2 Transmission and distribution

The transmission of electricity is achieved through legally unbundled transmission system operators (TSOs). In 2004, the European Commission (Case No COMP/M.4110 - E.ON / ENDESA pg. 10) reported that *"The operation and management of the high voltage grid (transmission) is for more than [75-85 per cent] controlled by the same four majors: RWE is again the strongest player with [30-40 per cent], closely followed by E.ON with [25-35 per cent] and Vattenfall Europe ([25-35 per cent]), whereas EnBW represents a somewhat smaller part of this market ([5-15 per ent]). In electricity distribution E.ON is the strongest player with a [20-30 per cent] market share, RWE has [15-25 per cent], followed at some distance by EnBW ([<10 per cent]) and Vattenfall Europe [<5 per cent]. Other companies jointly represent [35-45 per cent]."* During subsequent years, not much has changed. In this Study we do not concentrate on the transmission and distribution levels.

6.2.3 Retail

The German retail energy market is also quite concentrated. The 'big four' firms (E.ON, RWE, Vattenfall, and EnBW) cover more than half of the market. In 2004, the European Commission noted (Case No COMP/M.4110 - E.ON / ENDESA pg. 10): "*E.ON is, furthermore, active in retail supply of electricity, both to large industrial customers and to small customers (private, commerce and public institutions). In the retail electricity supply to large industrial customers RWE is market leader ([20-30 per cent]), closely followed by E.ON ([15-25 per cvent]), EnBW ([10-20 per cent]) and Vattenfall ([10-20 per cent]). The remaining part of this market consists of smaller players, such as MVV, EWE, RheinEnergie and others. In the market for retail supply to small customers E.ON leads ([5-15 per cent]), followed by RWE ([5-15 per cent]), and RWE and EnBW [should read: EnBW and Vattenfall] with [<10 per cent] and [<10 per cent] respectively. Other companies, including EWE and RheinEnergie, collectively represent [55-65 per cent] of this market*."

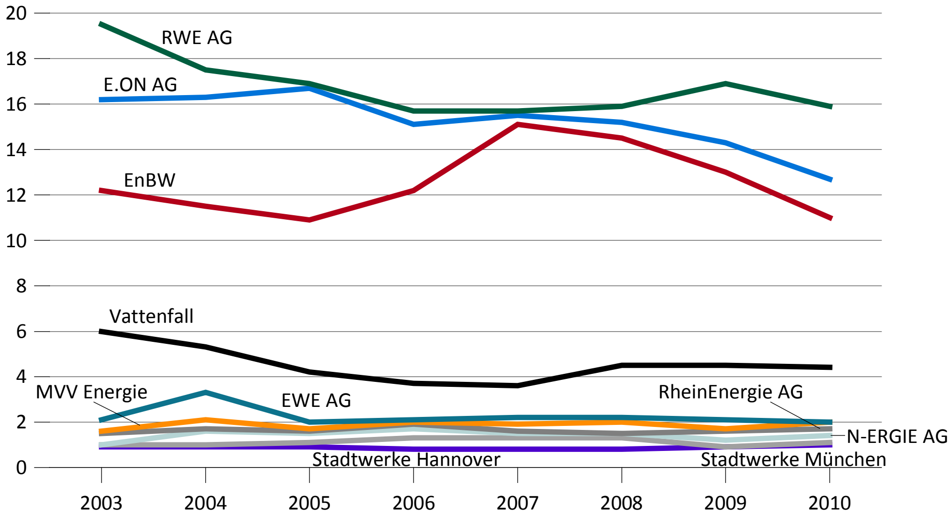
Although there were some dynamics in the evolution of national market shares of the main players during the 2000s, looking at national market share, the overall picture did not change too much (see Figure 6.3).[58] All big players lost some market share over time. Yet looking at national level, they continue to cover almost half of the market.

concluded that "*the non-operation of profitable power plants identified in the present inquiry is too limited to initiate specific abuse proceedings with respect to the period examined*" (Bundeskartellamt, 2011, pg. 6).

[57] For instance, Ockenfels et al. (2008) report that only 15% of energy consumption was traded at the EEX in 2008. In its final report for 2013, the EEX press release mentions that "The market share of EEX in the German market arose by 1/3 to ca. 20%" (http://www.eex.com/blob/66776/8ea17d8bc1445c4113d8774772d6dee8/pr-20140114-eex-jahresrueckblick-pdf-data.pdf).

[58] Please note that The market shares of the smallest firms are not reported so that market shares do not sum to100.

Figure 6.3 Time Evolution of National Market Shares



Source: Bundesverband der Energie- und Wasserwirtschaft (BDEW), Berlin.[59]

Regional markets

This rather aggregated picture could be partially misleading. Retail energy markets are regional in scope, at least concerning households and small commercial customers. In its monitoring report in 2010, the German regulator stated: '*Geographically, the relevant market for the supply of basic household costumers ('Grundversorgungskunden') has to be defined at the level of the coverage area ('Versorgungsgebiet') – i.e., the low voltage network necessary to supply [energy].* (Bundesnetzagentur, Monitorbericht (2010) p77-79).

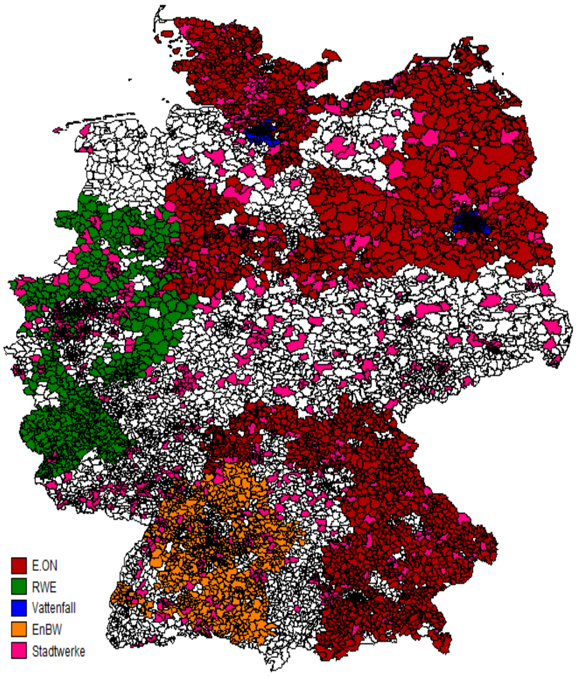
These regional markets defined by the coverage areas ('Versorgungsgebiete') differ substantially in terms of market structure, level of competition and, accordingly, retail prices. In particular, the four big players upstream are also incumbent ('Grundversorger') downstream in different regions.[60]

Several of the small vertically integrated operators (particularly the 'Stadwerke') are also incumbents in different regional markets, generally in the municipalities where they operate. Figure 6.4 represents the geographical dispersion of these vertically integrated operators. The white spots represent coverage areas where the incumbent is either an independent and non-integrated operator or has a mixed ownership structure and it is partially owned by one or more of the big players and or one municipal firm.

59 https://www.bdew.de/internet.nsf/id/C125783000558C9FC125766C0003E862/$file/130314_TopTen%20Marktanteile%202003%20bis%202010_Stand%20Mrz2013.pdf.

60 According to the EnWG, the 'Grundversorger' is the firm that serves the majority of household costumers in a local market ('Netzgebiet') at a given point in time. The incumbent provider is newly defined every three years.

Figure 6.4 Incumbents in regional retail markets in 2010



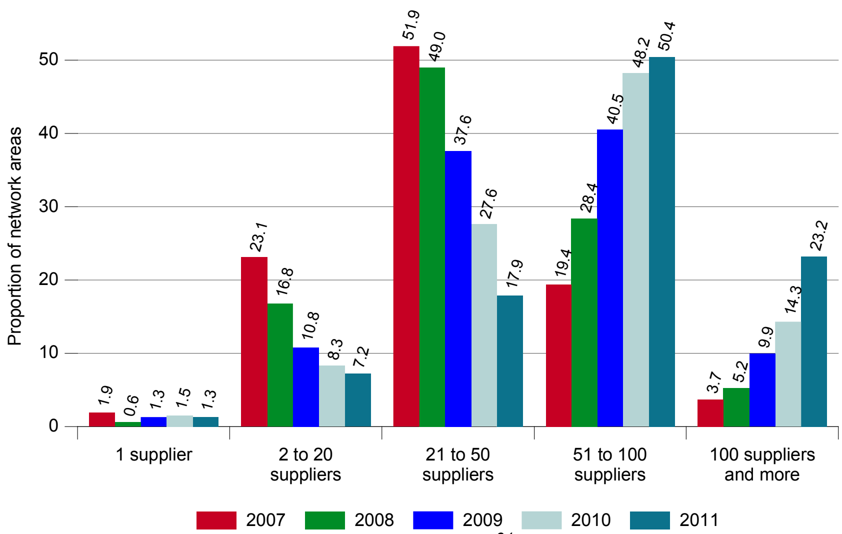
Source: Own calculations based on Verivox data.

While in each of these regions several retailers offer different tariffs, incumbent operators are legally obliged to sell energy at a baseline tariff (‘Grundversorgungstarif’) to all household customers who do not explicitly choose another provider. Accordingly, this baseline tariff constitutes an upper bound for the energy retail prices in a given region because it is automatically chosen by customers unwilling or lacking the information to switch supplier. As a consequence, incumbent operators have particularly high market power over their customers. So these tariffs should also be expected to be less responsive to changes in wholesale tariffs if compared to those offered by the competitive fringe to more informed customers with lower switching costs in that region.

Switching costs

Although German electricity retail markets were liberalised in 1998 (which resulted in substantial new entry), and each retailer has non-discriminatory access to all customers in each regional market, there is very little switching among household customers. The German regulator mentioned that each customer on average had a choice of 124 operators in each regional market in 2010. Yet, the number of energy suppliers in the regional markets varies considerably (see Figure 6.5)

Figure 6.5 Proportion of Network areas in which a given number of suppliers is active



Source: Bundesnetzagentur, Monitoringbericht, 2012[61]

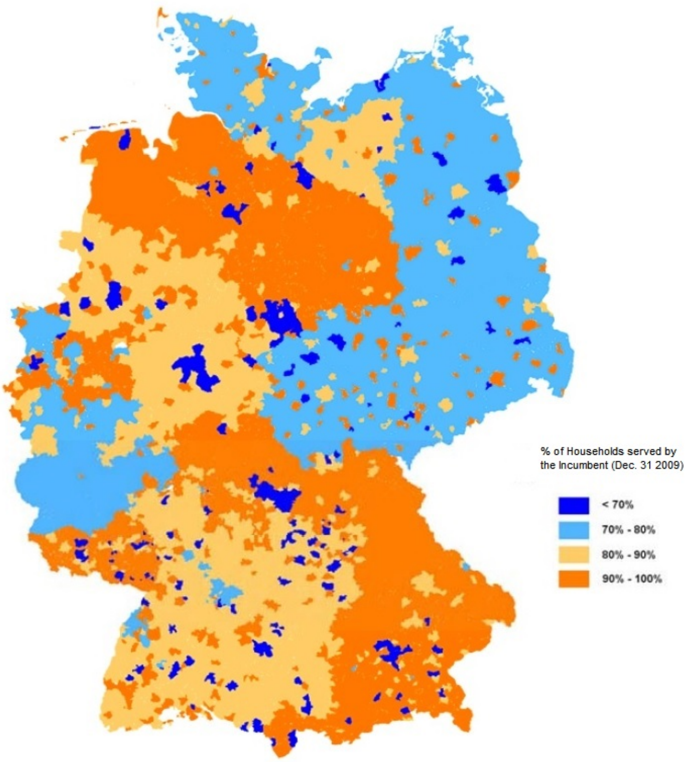
Most of these retailers are small firms operating regionally. The German regulator mentions that almost two-thirds of the retailers operate in at most 10 local network areas. However, between 2007 and 2011, the number of retailers operating in more than one local area has substantially increased.

Notwithstanding the steady increase in the number of competing retailers in each local market, German household customers show a great degree of inertia. In 2009, incumbent operators still served more than 70 per cent of the households in most German regional markets (Bundesnetzagentur, Monitorbericht (2009)).[62] Figure 6.6 shows the geographical distribution of the percentage of households served by the incumbent. Moreover, most of these customers (on average more than 45 per cent) are still served at the most expensive baseline tariff.

61 http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Allgemeines/Bundesnetzagentur/Publikationen/Berichte/2012/MonitoringBericht2012.pdf?__blob=publicationFile

62 http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen_Institutionen/DatenaustauschUndMonitoring/Monitoring/Monitoringbericht2009.pdf?__blob=publicationFile&v=1

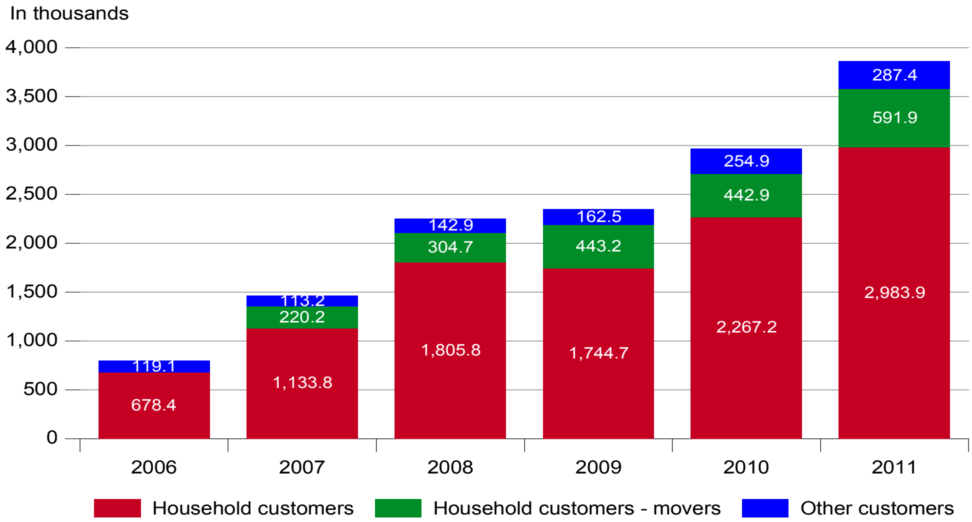
Figure 6.6 The geographical distribution of household customers' switching behaviour



Source: Bundesnetzagentur, Monitorbericht 2009

During subsequent years, the amount of households that switched operator grew at an increasing rate but incumbent operators maintained a very strong customer base (Figure 6.7)

Figure 6.7 Number of Final Customers Switching Providers

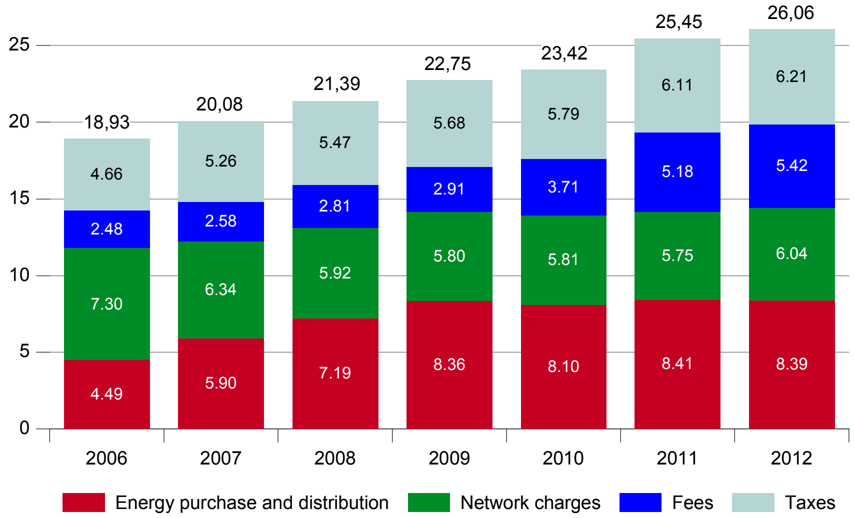


Source: Bundesnetzagentur, Monitoringbericht 2012

Retail price structure

Part of our empirical analysis focuses on retail prices, making it important to clearly understand their relationship with wholesale prices. As explained in Section 2, retail tariffs entail several components. On the one hand, they are affected by electricity wholesale prices that constitute the main essential input for retailers, but are also strongly influenced by other factors such as the (regulated) cost of transmission and distribution as well as taxes and other fees. In its 2012 monitoring report, the German regulator discusses in depth the structure of retail tariffs for household customers, whose national average composition for the period relevant for our study (2007-2012) is reported in Figure 6.8.[63]

Figure 6.8 Development of Energy Purchase Prices – Weighted Averages over all Tariff Types

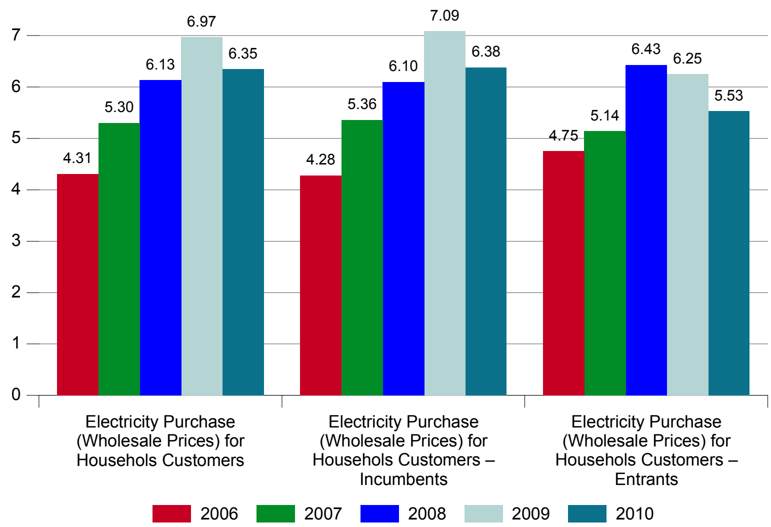


Source: Bundesnetzagentur, Monitorbericht 2012

Energy purchasing strategy

While these average values are useful to understand the various components of retail tariffs, they also present a lot of cross-sectional variation across and within regions. The German regulator mentions that the cost of energy purchase varies within different types of firms. Since 2007, entrants achieved on average more favourable conditions mostly because they buy energy from the wholesale markets through shorter-term contracts and wholesale energy prices have decreased. Figure 6.9 shows the development of energy purchase prices on average and differentiating between incumbents and entrants (Bundesnetzagentur, Monitorbericht (2012)).

Figure 6.9 Development of Energy Purchase Prices – Weighted Averages per Tariff Type



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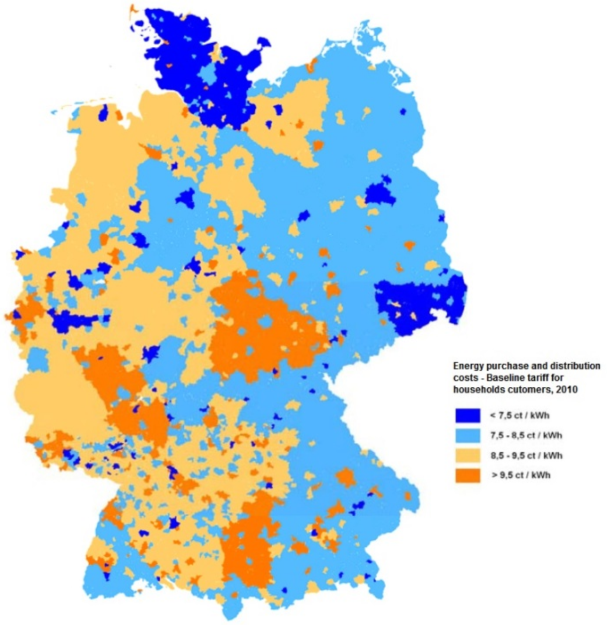
63 An additional in-depth analysis of the composition and trends of retail prices across European country can be found in the Commission staff working document "Energy prices and costs report" from the Council and the European Economic and Social Committee and the Committee of the regions Energy prices and costs in Europe. For Germany in the second half of 2012 the average household electricity price of 26.8 Eurocent per kWh is broken down as follows: 8.3 Eurocent energy cost, 5.9 Eurocent network, 12.4 Eurocent taxation.

Source: Bundesnetzagentur, Monitorbericht 2010

There also appears to be a substantial regional variation in electricity purchase and distribution costs as documented in Figure 6.10.

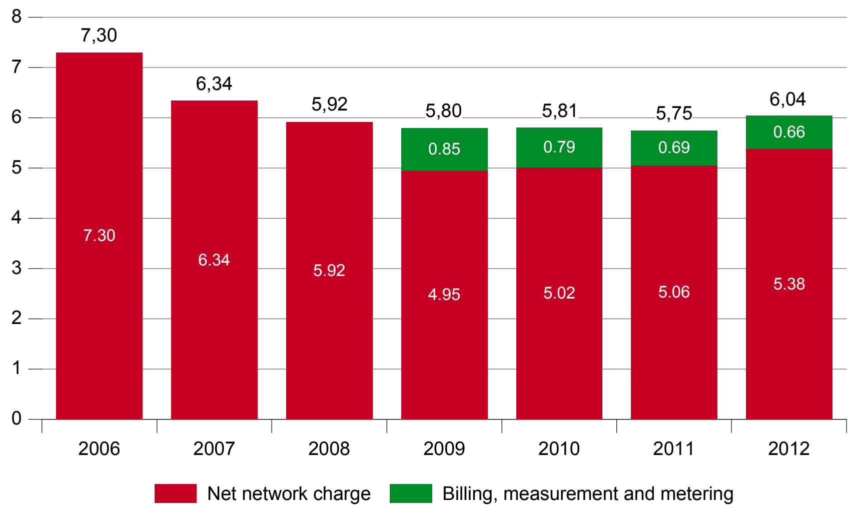
Figure 6.10 Regional Variation in Energy Purchase Costs.



Source: Bundesnetzagentur, Monitorbericht 2010

Final retail tariffs are also influenced by interconnection fees ('Netzentgelte'). On average, these decreased from 7.30 to 5.81 ct/kWh between 2006 and 2010 and then increased again during subsequent years (Figure 6.11). But there is some regional heterogeneity in the level of such fees.

Figure 6.11 Development of Network Charges for Household Customers

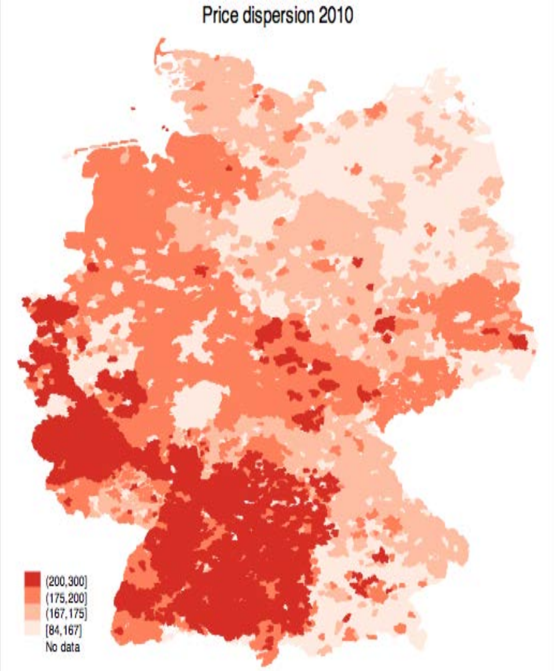


Source: Bundesetzagentur, Monitoringbericht, 2012

Heterogenous retail tariffs

The heterogeneity in energy purchase costs, consumer switching behaviour, and network costs described above results in significant price dispersion within local markets. Typically, the most expensive tariff is the baseline tariff offered by the local incumbent, while the cheapest alternative tariffs are typically offered by smaller competitors. In Figure 6.12 we represent the yearly average of the within-network area price dispersion in 2010 expressed as the difference between the average baseline tariff (the most expensive tariff) and the average cheapest tariff available in each zip code for a typical consumption of 2,800 KWh per year. The different colours represent the quartile of the price-dispersion distribution.

Figure 6.12 Within-Network Areas Price Dispersion – 2,800 KWh yearly consumption (2010)



Source: Our calculations based on Verivox Data

There is significant price dispersion in each area and significant cross-area differences in the size of this dispersion. It varies between €65 (lowest value of the first quartile) and €300 (highest value of the fourth quartile). This is quite substantial given that the average price for that consumption bundle is around €600. In our empirical analysis, we exploit this large heterogeneity in energy retail tariffs prices within and across regional markets to identify the effect of the Commission's decision.

6.3 Overall approach to the analysis

Given that E.ON's alleged abuse of dominant position directly affected wholesale markets, the natural starting point for an ex-post study would be to look at the *wholesale prices*. As mentioned, since 2002, the German wholesale energy market has been determined through the EEX market located in Leipzig. For the sake of an evaluation study, it is useful to use readily available and transparent EEX prices extensively used in the literature on energy markets.

A potential issue here is that most energy trade between wholesalers and retailers in Germany is done by means of OTC long-term bilateral contracts between producers and suppliers, while only a small but increasing percentage of energy trade is covered through the EEX.[64] But since OTC prices should be expected to at least correlate to the EEX prices (e.g., Zachmann and Von Hirschhausen (2008)) which constitute a benchmark or opportunity cost for energy trading, analysing the evolution of EEX prices will potentially represent the effect of competition on upstream energy markets.

While the wholesale market seems to be a reasonable starting point for a retrospective evaluation of the Commission's decision, the ultimate goal of competition policy is to

[64] For instance, Ockenfels et al. (2008) report that only 15% of energy consumption was traded at the EEX in 2008. In its final report for 2013, the EEX press release mentions that "The market share of EEX in the German market arose by 1/3 to ca. 20%" http://www.eex.com/blob/66776/8ea17d8bc1445c4113d8774772d6dee8/pr-20140114-eex-jahresrueckblick-pdf-data.pdf.

enhance consumer welfare. Hence, an additional important variable to look at in this Study is the price final customers pay to consume energy. *Retail prices* will therefore be an additional focus of our analysis. Equally important is that the retail-market analysis cannot be considered part of the ex-post evaluation of the Commission's decision. Whether or not potential savings in the upstream wholesale electricity markets are passed through to consumers does not depend on the Commission's intervention but on the competitive structure of the downstream retail electricity market.

The aim of the retail analysis is therefore to allow us to investigate the more general (and, perhaps, crucial) issue of under which conditions the beneficial effects of competition in upstream energy markets are passed on to final costumers. Whether and when retail prices might have been influenced by upstream changes spurred by the Commission's decision is unclear. To answer this question we build an empirical framework based on the specificities of German electricity markets which define our identification strategy

First, energy retailers are structurally different in the degree of vertical integration with wholesalers and producers, their size, geographical scale, ownership structure, and objectives. These structural differences also affect their energy purchasing strategies and, particularly, the type and length of long-term contracts they stipulate with the wholesalers. Therefore, heterogeneous retailers are expected to have different incentives to pass-on upstream savings to downstream markets. Specifically, large, vertically integrated incumbents are expected to have less incentive to quickly pass-on than small, non-vertically integrated incumbents.

Second, the pass-on of changes in wholesale prices to retail tariffs depends on the extent of downstream market power. The large perceived retail costumers' switching costs - particularly for private households - create a stable customer base for incumbent retailers, which can be exploited with high tariffs (e.g. Hviid and Waddams (2012)). Hence, incumbent firms are less likely to pass-on reduced costs than other competitors.

Third, most contracts among energy suppliers and retailers are long-term. Therefore, if at all, one would expect the impact of the Commission's decision on retail prices to come into effect gradually as old supply contracts are successively replaced by new ones, meaning one should only expect slow changes in retail prices following changes in wholesale prices.

Finally, other important factors such as the (mostly regulated) cost of transmission and distribution and taxes affect retail prices. Wholesale energy prices constitute only a small part —in Germany ca. one third— of retail tariffs.[65] As a consequence, regional and temporal variability in retail prices can potentially be explained by other factors, which need to be controlled for.

For both outcome variables - *retail prices* and *wholesale prices* - we suggest a difference in difference (DiD) approach to identify the effect of the EU enforcement decision. This methodology looks at markets/firms/products that are similar to those affected by the conduct and the subsequent policy decision (treated) but which themselves are unaffected (control) or, at least, less affected.

The identification strategy exploits both time and cross-sectional variation in the main outcome variables to identify the effect of the decision. It compares the differences in the average behaviour and outcomes of the treated group, before and after the conduct and policy decision, with the difference in the average behaviour of the control group, during the same time span.

This double differencing removes the time invariant individual effects (of treatment and control group) and the common time effects that might be otherwise confounded with the effect of the conduct and policy decision. It allows the identification of the average causal effect of these actions. The two main issues for identification of the causal effect are

65 An in-depth analysis of the composition and trends of retail prices across European country can be found in the Commission staff working document "Energy prices and costs report" from the Council and the European Economic and Social Committee and the Committee of the regions Energy prices and costs in Europe. For Germany in the second half of 2012 the average household electricity price of 26.8 Eurocent per kWh is broken down as follows: 8.3 Eurocent energy cost, 5.9 Eurocent network, 12.4 Eurocent taxation.

therefore (i) the choice of the counterfactual (treated vs. control groups) and (ii) the choice of the before-and-after periods. In Appendix 1, we present a short non-technical discussion of the DiD methodology.

6.4 An econometric analysis of the wholesale market

In theory, the effect of the Commission's decision on wholesale prices is straightforward. The divestiture of generation capacity should lead to an increase in competition since the production facilities have been mostly purchased by several medium players in the upstream power market and not by one of the other dominant players. This increase in competition should lead to an increase in energy supply, which implies an outward shift of the supply schedule. Subsequently, wholesale prices should decrease *ceteris paribus*.

Yet, it is difficult to clearly identify and empirically measure this impact since there are several demand-side and supply-side price drivers (omitted factors) which might correlate to the (timing of) Commission's decision and need to be controlled for. Complex structural models may allow one to identify the effect of the policy intervention more precisely, but they are very data intensive and rely on mostly untestable assumptions and calibrations. As this approach is not feasible with the data available, we adopt a difference-in-difference (DiD) framework to identify the causal effect of the Commission's decision similar to the approach proposed for the retail market.

As explained above, the effect of the policy intervention is then identified within a framework of a quasi-natural experiment where the behaviour of a treatment group, which is mostly affected by the policy, is compared to the behaviour of a control group, which is not (or to a lesser extent) affected by the intervention. Ideally, the control group would consist of the same people affected by the treatment had they not been treated. Since this is just a theoretical counterfactual situation, other strategies have to be chosen to construct a control group. For this case study, we choose a strategy based on a within-country comparison. We look at two different outcomes in Germany = the peak and off-peak wholesale electricity prices - that should have been differently affected by the policy decision. They constitute the two 'groups' in our DiD framework.

Looking at the different evolution of the two outcomes before and after the implementation of the divestitures, we expect to identify the causal effect of the Commission's decision. A main advantage of this approach is that the performance of the two groups is equally affected by their common institutional drivers. Hence, we might be less worried about potential institutional differences across the two groups that are more likely in an across-countries comparison. Put differently, the common trend assumption is more likely to hold conditional on adjusting for the most crucial drivers of peak and off-peak prices. To control these different dynamics, we use demand and supply conditions that are different between peak and off-peak periods.

6.4.1 The basic framework: A DiD Approach

The basic empirical model we use to analyse the German wholesale energy market consists of a price equation, where the wholesale price is a function of demand and supply drivers. Our model is based on Böckers and Heimeshoff (2014) and takes the following form:[66]

$$\begin{aligned} p_{it} = {} & \beta treat_i + \gamma post + \delta treat_i \times post + \alpha_1 wind_{it} + \alpha_2 sun_{it} \\ & + \alpha_3 cross-border\ flows_t + \omega_1 uranium_t + \omega_2 coal_t + \omega_3 gas_t \\ & + \omega_4 oil_t + \omega_t emission_t + \sum_{y=2008}^{2012} \theta_y Y_{y,t} + \sum_{m=1}^{11} \vartheta_m M_{m,t} + \sum_{d=1}^{6} \mu_d D_{d,t} \\ & + \rho_1\ temp_{it} + \tau_1 holiday_t + \epsilon_{it}. \qquad (1) \end{aligned}$$

The daily power price p_{it} at day *t* for the group *i* —peak vs. off-peak— is regressed on demand-side variables such as seasonal and business cycle dummies (day *D*, month *M*,

[66] In a model with time fixed-effects, the dummy post is generally not identified it is collinear with the year dummies. See footnote 71.

year *Y*, peak and off-peak temperature, and *holiday*). To address the crucial issue of integration of European energy markets that created pricing constraints imposed by competition from neighbouring countries,[67] we included a variable measuring the cross-border electricity flows ($Crossborder\ flows_t$) as well as a dummy for the market-coupling period.[68]

Supply-side controls are the prices of input factors, represented by price indices that cover the daily international prices for commodities such as coal, gas, oil, and emission certificates (*coal*, *oil*, *gas*, and *emission*), equal across *i* for a given day *t*. Another crucial control is the actual production of renewable energy (*wind* and *sun*) that substantially shifted the supply schedule.[69] Since there is no complete data on actual sun energy production for the entire sample period, we proxy for it with its most important drivers, as discussed in the data section. [70]

Finally, the error terms are assumed to be auto-correlated and heteroskedastic. We therefore estimate Newey-West standard errors and assume the maximum lag order of autocorrelation to be equal to one week (seven days). Since the assumptions on the error term are crucial to accurate inference, we then perform several robustness checks to test their relevance to our results.

The dummy *treat* is equal to 1 for the 'treated' prices, i.e. those prices that should be (mostly) affected by the Commission's decision, while the dummy *post* is equal to 1 during the period following the termination of the alleged abuse and the implemented remedies. We examine the definition of these variables in the following sections. The double differencing implied by a DiD framework and the inclusion of a large set of common demand-side and supply-side drivers will help mitigate endogeneity problems due to omitted variables and create more confidence on the causal nature of the estimated treatment effect.

6.4.2 Identification of the treatment group: treatment peak vs. off-peak prices

As discussed above, the proposed identification strategy is based on the different price response to the Commission's decision between peak (8am-8pm) and off-peak prices (9pm-7am). Hence, the definition of the treatment group follows this dummy variable:

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[67] Alternatively, we tried some specifications where we introduced the price of neighbouring countries in equation (1) as control variables. Indeed, power exchanges across Europe have increased cooperation and set up projects to couple their markets. In this way, power prices of different regions are closely linked one to one another. A major issue of this approach is that prices in other countries are clearly endogenous to German prices. The large number of potentially endogenous variables makes an instrumental variable (IV) approach difficult to implement in this setting; we therefore, opted for a control-function approach. In this approach, prices are split into an exogenous and an endogenous component. The exogenous components are the country-specific cost and demand drivers. Unfortunately, we had very limited information for this country-specific exogenous component as most of the cost drivers (input prices as well as day, month, and year dummies) are common to all countries. Therefore we abandoned this approach.

[68] The market coupling mechanism was introduced to optimize of the allocation process of cross-border capacities. It works via a coordinated calculation of prices and flows across countries based on implicit auctions. We take November 2010 as the date of the introduction of a Central West European market coupling mechanism that covers Germany, Benelux, and France.

[69] Potentially, it might be important to control for additional new installed capacity from conventional—rather than renewable— sources as it might also influence the supply schedule. Data from the German regulator for the period 2007-2014 suggest that the large increase in generation capacity over the sample period comes from renewable sources. Only during the second half of 2011 some substantial changes in the generation of capacity can be observed due to the shutdown of nuclear plants following the Fukushima's accident. The reduced nuclear capacity was however compensated by an increase of gas power plants' capacity. The net change was lower than 2,000 MW and much smaller than the change in generation capacity due to renewable. Hence these changes cannot substantially affect our results.

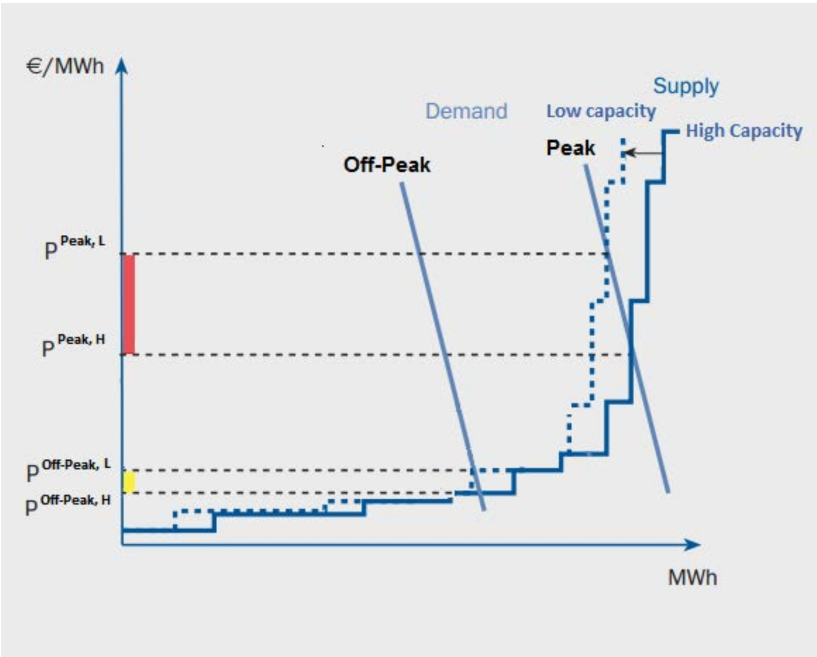
[70] Indeed, the boom of wind and solar production capacity spurred by the de-carbonisation of energy supply in Germany as well as in all other European countries drastically changed the functioning of power market over the past decade. Specifically, the introduction of increasing renewable electricity production changed the merit order schedule and, accordingly, the resulting market prices. The renewable energy installed capacity has started to substantially increase after 2007 and did so during the entire sample period.

$$treat_i = \begin{cases} 1, & if \quad Peak\ Demand \\ 0, & if \quad Off-peak\ Demand \end{cases}$$

Figure 6.13 explains the logic of our identification. The premise is that energy suppliers have more market power during peak periods where demand is higher due to business activities. Since the supply schedule is highly convex and is much steeper during the peak period, a shift to a lower capacity schedule obtained if capacity is withdrawn from the market would have much larger effects during peak time.

The difference in the peak price between the high capacity scenario ($P^{Peak,H}$) and the low capacity scenario ($P^{Peak,L}$) is much larger than the difference in the off-peak price between the high capacity scenario ($P^{Off\text{-}Peak,H}$) and the low capacity scenario ($P^{Off\text{-}Peak,L}$). Hence, a policy intervention that shifts the supply schedule to the 'high capacity' scenario should most critically reduce market power, and therefore prices, during peak hours with a much smaller effect off-peak.

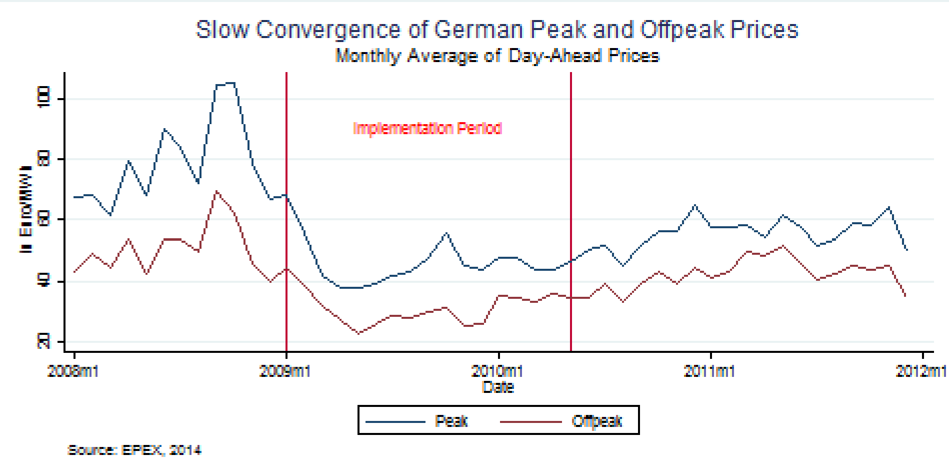
Figure 6.13 Differential Effect of a shift in Supply Peak vs. Off-Peak Prices



Source: Own representation

Consequently, for each trading day, we create two series of prices according to peak and off-peak periods. Figure 6.14 represents the evolution of the monthly average day-ahead prices during peak and off-peak periods. We represent monthly averages to wash out the extreme daily price volatility and make the comparison clearer. While there is some seasonal variability, both prices have been dropping since 2009, and there is a slight and slow convergence among the two series after 2009.

Figure 6.14 German Monthly Peak vs. Off-Peak Prices



Clearly, this descriptive evidence only *suggests* a possible convergence. In our econometric exercise, we need to control for other factors affecting the evolution of prices to avoid problems of endogeneity, i.e., to causally identify the effect of the Commission's decision, which is precisely the purpose of model (1).

6.4.2.1 *Potential alternative counterfactuals and why we did not choose them*

We considered alternatives to define the control group based on cross-country comparisons, but decided not to pursue them. First, we considered choosing as a control group a country structurally similar to Germany but not impacted by any alleged abuse, merger, or other relevant competition policy decision during the sample period. Selecting such a country has proved difficult. Germany has a unique electricity market, particularly since it pursued a 'green-strategy' (the so called *Energiewende*).This makes it essentially impossible to find another national market to compare it with.

Direct neighbours are a poor counterfactual because electricity markets are becoming increasingly connected so cannot be regarded as fully independent of each other. Even markets not strongly connected to Germany are a poor counterfactual if they have been affected by some competition policy interventions during the sample period. While we abandoned this identification strategy, we identified two potentially interesting markets for comparison and used them in a 'placebo' robustness check, described below.

A second, promising approach relies on the creation of a so-called synthetic control group (e.g., Abadie, Diamond and Hainmueller (2010)) to make causal inference in the presence of a large cross-section of non-treated observations, none of which is perfectly similar to the treated group.

It consists of creating a synthetic, hypothetical market, whose outcome pre-treatment almost perfectly matches the outcome of the treated group. In our case, this 'synthetic group' could be constructed as a weighted average from a selection of other countries and represents Germany as it would be, had it not been treated by the policy decision. The difficulty of this approach lays in the selection of suitable candidates countries to be included in the creation of the control group. It is also data intensive, requiring a potentially large set of key control variables that affect the outcome variable, i.e. energy prices, not only for Germany but also for all other countries used to construct the control group.

In a substantial data collection exercise, we gathered quite complete information on wholesale prices and their drivers for Belgium, the Czech Republic, Denmark, France, Switzerland, Netherlands, Poland, and Sweden. By using the 'synth' command in Stata, we tried to generate a synthetic control group for the two German prices (peak and off-peak) using energy consumption, temperature, and holidays as observable characteristics.[71]

[71] Unfortunately, several other important drivers of wholesale energy prices — input prices such as gas, coal, etc.— are country-invariant as they are purchased at the global commodity market and could not been used

For each of the prices we implement two procedures: one based on daily data and one based on monthly data. The procedure would produce a reliable control group if the German pre-treatment prices were almost perfectly matched by the prices generated for the synthetic control group in the pre-treatment period. Unfortunately, the different specifications produced very poor results. We could not match German electricity prices in a satisfactory way by using the synthetic control group and abandoned this approach.

6.4.3 Identification of the treatment period

The second crucial element of our identification strategy is the definition of the *treatment period*, i.e., the time during which the decision's effect materialised. We defined three major periods: the *before* period (up to December 2008), the *implementation* period during which the remedies were implemented (January 2009 to April 2010), and the after period (since May 2010). Given the high frequency of our data and because wholesale energy markets are very dynamic and could respond swiftly to changes in supply conditions, we consider four different impact scenarios that should allow us to identify both the short-term and long-term effects of the policy intervention. The advantage of the short-run scenario is to try to identify the effect of each single remedy and focus on a very short time period. This lowers the risk of contaminating the effect of the intervention with other, unobserved factors but the effects of an important policy intervention could be much more pervasive. Therefore, it seems reasonable to look at long-term effects and at the impact of the decision over several years. The disadvantage of the long-term analysis is that the precise causal identification of the policy intervention might be weakened by the existence of confounding factors, particularly in such a liquid and dynamic market.

Long-Run Effects of the Decision

In this approach, probably the closest to a standard DiD analysis, we assume that the Commission's decision had long-lasting effects. We then consider two possible situations. First, we assume that these effects are apparent as soon as the Commission's decision was implemented. We thus construct the dummy variable that takes on a value of 1 from the first divesture onwards, including the implementation year 2009:

$$Post_t = \begin{cases} 1, & if \quad date > Dec\ 31\ 2008 \\ 0, & else \end{cases}$$

Alternatively, we assume that the overall effect of the decision can only be observed when the last remedy has been implemented. We thus define the post period from the May 10 2010 onwards and exclude the year 2009 from the analysis.

$$Post_t = \begin{cases} 1, & if \quad date > May\ 10\ 2010 \\ 0, & if \quad date < Jan\ 1\ 2009 \end{cases}$$

Cumulative Short-Run Effect of the Remedies

In the second approach, the impact of the divesture is assumed to be immediate and short-lived. Thus the dummy variable *post* takes on the value of 1 for the week after each of the eight divestures. One week after each divestiture *j* out of the *J* divestitures, the dummy then turns to zero again and it then turns to 1 again when the next divestiture is implemented.

$$Post_t = \begin{cases} 1, & for\ d_j = t_1, \dots, t_1 + 6; \dots; t_J, \dots, t_J + 6 \;\; d_j = day\ of\ Divesture\ j, \quad j = 1, \dots, J \\ 0, & else \end{cases}$$

in the analysis. Moreover, one main variable that is unfortunately not available for all countries but that plays a crucial role in affecting the evolution of wholesale prices is the daily actual solar and wind energy production.

Hence, the coefficient's estimate for this dummy measures the average cumulative short-term effect of all divestiture together.

Individual Short-Run Effect of the Remedies

Since the effects of each divestiture might be heterogeneous, we then split this average effect on separate effects for each of the different divestitures *j*. Also in this case, we measure short run effects covering one full week after completion of the divestiture. We will then have *J* dummies, one for each divestiture of the form:

$$Post_{t_j} = \begin{cases} 1, & for\ d_j = t, \ldots, t+6\,, \quad d = day\ of\ Divesture\ j, \quad j = 1, \ldots, J \\ 0, & else \end{cases}$$

This scenario allows us to more flexibly identify the short run effects of each divestiture. However, the identification comes from a small number of observations. Specifically, it comes from seven observations around each divestiture, making this model much more refined and flexible, but potentially less robust. However, the coefficient estimates in this case cannot be interpreted as treatment effects. This specification resembles much more an event study and the aim is to measure whether there have been quick price adjustments around the implementation of the single remedies.

6.4.4 Robustness check: Placebo regressions using France and Spain

As mentioned above, instead of using other countries as alternative control groups, we chose a 'placebo' scenario. We selected France and Spain as two countries that share similarities with Germany and where we have good data, particularly regarding the production of renewable energy and cross-border flows. These two countries also share the peculiarity of being more (France) or less (Spain) connected to Germany through common borders. We then implement the same identification strategy used for Germany on the French and Spanish prices, comparing peak and off-peak prices and using the same definition of the before and after periods.

If the chosen 'placebo' markets are independent from the German market and our divestiture dummies identify the effect of the Commission's decision rather than other omitted factors, there should not be any significant results for the 'placebo' markets. But since the French electricity market is potentially more integrated with Germany than Spain, we might expect some potential spill-over effects of the E.ON decision on French wholesale electricity prices.

This is useful to verify whether our identification of the short-term effect of the remedies was accurate. Specifically, if we found significant results for the single divestiture in Spain, a country that should not be affected by the behaviour of the German market, we could conclude that our divestiture dummies are measuring shocks other than the effect of the specific remedy. To summarise, we do not expect to see any of the effects observed in Germany in the Spanish market, but do expect them in France.

6.4.5 The data

The data for the wholesale analysis come from different sources. The power exchange prices are taken from the respective (national) power exchanges and come from the Platts database. The coal price is a combined price series of two sources (Platts and Argus McCloskey), which is adequate since they are extremely highly correlated and measure the daily European reference price for coal imports into North-western Europe.

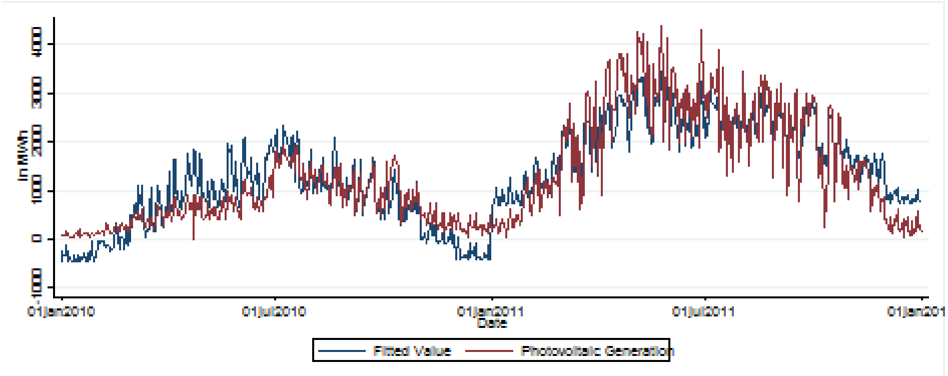
The oil price index is chosen from ICE Brent Europe (in $/tonne), the gas price reference is that of ENDEX/TTF and the emission price is the weighted emission certificate price from the EEX. Electricity consumption is retrieved from the ENTSO-E country packages and measured in MWh.[72] Temperature data during peak and off-peak periods in degree Celsius (Deutscher Wetterdienst (2014)) is included in our main model in both linear and quadratic form to account for the non-linear relationship between temperature and consumption as well as the relationship between temperature and power production.

Data on wind and solar power production is retrieved from the website of the four network operators. As data on photovoltaic generation is not available on a daily basis before 2010, we need to use proxy variables for solar production. To motivate our choice, we collected data on the annual installed capacity from 2010 onwards (*inst_solar*) taken from BDEW (2014) and Solarwirtschaft.de (2014) and daily sunshine duration in minutes (*sun per day)* which is retrieved from the Deutscher Wetterdienst (2014). We then use an auxiliary regression to explain the power produced by solar generation. We estimate the following regression:

$$solar_t = constant + sun\ per\ day_t + installed\ cap_t + \sum_{m=1}^{11} \vartheta_m M_{m,t} + \epsilon_t$$

We then compare the observed daily capacity to the prediction of the model for the time period during which we do observed solar capacity. The model fits the actual data quite well (Figure 6.15). Hence, we use the explanatory variables from this regression as a proxy for solar production for the entire sample period.

Figure 6.15 Solar capacity: Actual vs. Fitted values



Source: Own representation of data from different sources (BDEW, 2014; Solarwirtschaft.de, 2014; and Deutscher Wetterdienst 2014)

Table 6.2 reports the preliminary statistics for the variables that will be used in our regression.

Table 6.2 The German Wholesale Electricity Market – Preliminary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Price	2,922	49.347	19.025	-69.756	174.395
Price peak	1,461	58.18	20.32	-6.64	174.4
Price off-peak	1,461	40.52	12.46	-69.76	80.59
Consumption peak	2,916	1,7927.2	18,271.55	0	45,821.27
Consumption off-peak	2,916	14,819.69	15,019.41	0	39,302.54
Temperature peak	2,922	3.299	4.563	-5.924	17.703
Temperature off-peak	2,922	2.258	3.411	-6.227	12.955
Wind	2,922	4,541.416	3,594.762	333.646	21,233.87
Solar	2,922	658.712	1,003.094	0	4,389.146
Sun per day	2,922	279.426	218.847	0	878.555

[72] Missing data is replaced by averages constructed by interpolation.

Variable	Obs	Mean	Std. Dev.	Min	Max
Installed cap	2,922	14,320.520	6,939.736	5,955	23,962
Divestiture	2,922	2.366	44.170	0	1,500
Cross-border flows	2,917	-400.84	1,505.68	-5,702.1	5,175.14
Cross-border flows peak	1,458	-487.42	1,628.32	-5,702.1	5,175.14
Cross-border flows offpeak	1,459	-314.32	1,367.31	-4,317.5	4,345.69
Oil price	2,922	87.316	24.905	33.73	143.95
Gas price	2,922	19.290	5.878	7.2	31.8
Uranium price	2,922	53.441	10.435	40	90
Allowance	2,922	9.968	6.169	0.015	16.865
Coal price	2,922	107.262	35.632	56	224.75

6.4.6 Main results: Peak vs. Off-peak Prices

In Table 6.3 we report the main results of our estimation. First, the model seems to well explain the data because we can capture between 73 and 79 per cent of the variation in wholesale prices. Second, we observe an average difference between peak and off-peak prices that varies between 31 €/MWh in the long run models to ca. 20 €/MWh in the short run. Third, we also observe an overall decrease in prices during the post period (‘cumulative post effect’), mostly defined from 2009 to 2011.[73] On average, all prices have decreased by seven to 20 €/MWh depending on the model adopted. Interesting for this study, is the interaction between Peak and Post, whose coefficients’ estimate measures the treatment effect, i.e. the differential evolution of peak prices if compared to off-peak prices after the implementation of the Commission’s decision.

Table 6.3 The Effect of the Divestitures on German Wholesale Prices

	Post 2010 (1)	Post 2009 (2)	Short-Run (3)	Single Div. (4)
Peak	30.84*** (1.89)	31.03*** (1.79)	19.68*** (1.00)	19.83*** (1.03)
Peak × Post	-15.37*** (1.65)	-14.58*** (1.66)	-3.22** (1.54)	
Peak × Div. 1				-2.48 (2.65)
Peak × Div. 2				-4.47*** (1.62)
Peak × Div. 3				0.18 (2.28)
Peak × Div. 4				3.57 (3.25)
Peak × Div. 5				-2.40** (1.19)
Peak × Div. 6				-9.55*** (2.16)
Peak × Div. 7				-4.37*** (1.31)
Peak × Div. 8				-6.54*** (2.27)
Constant	40.32*** (7.46)	38.38*** (6.33)	46.66*** (7.92)	47.89*** (8.24)
Cumulative post effect	-7.09*** (2.74)	-11.85*** (4.30)	-20.06*** (4.97)	-20.84*** (5.62)

[73] Since we use year dummies in the regression, the ‘post’ dummy is not identified. Therefore, the ‘post’ effect is calculated as the sum of the coefficients’ estimates for the years dummies, what we call the ‘cumulative post-effect’. In the specification represented in column (1) where we drop the year 2009, we sum the estimates for the 2010 and 2011 dummies, while in column (2) to (4) we sum the estimates for the 2009, 2010, and 2011 dummies.

	Post 2010 (1)	Post 2009 (2)	Short-Run (3)	Single Div. (4)
N	2190	2916	2890	2916
Adj. R^2	0.7800	0.7900	0.7626	0.7625

The dependent variable is the daily average peak or off-peak price at the EEX power exchange. We control for input prices (gas, oil, coal, uranium, and emission), day, month, and year dummies, solar and wind energy production, temperature, cross-border capacities, market coupling, as well as holydays. Newey-West standard errors with maximum lag order of autocorrelation equal to seven days are reported in parentheses. The symbols ***, **, * represent significance at the 15, %%, 10% levels respectively.

For the **long-run** scenario we find **a significance convergence between peak and off peak prices**. This effect is not only statistically significant but also economically very large. Independently of whether we look at post-December 2008 or post-March 2010 where we exclude the entire implementation periods, there is a significant reduction of peak prices with respect to off-peak prices of around 15 €/MWh, *other things equal*. This convergence seems to be more marked than our descriptive observation represented in figure 1.15. This is most likely because changes in input prices and renewable capacity would partially offset this convergence. So it seems particularly important to control for these additional drivers of the prices.[74]

Looking at **short run** effects, we also obtain **negative and significant coefficient estimates for the dummies measuring the interaction between 'peak' and the divestitures,** which hint at a short-run price convergence in the week around the implementation of the remedies. In the specification where we assume an average short term effect of the remedies, we find a smaller convergence of around 3 €/MWh between peak and off peak prices if compared to the long run effects. This is strongly significant different from zero.

The second specification is even more demanding in terms of identification and tries to separately identify the short time reaction around each single divestiture. Therefore, it should be taken even more cautiously, particularly because these effects cannot be interpreted as short-term average treatment effects.

According to our estimates, five of eight divestitures have a negative and significant impact on the difference between peak and off-peak prices. For the three remaining, there is no significant effect. The divestiture-specific convergence effect varies between two and nine €/MWh. These findings could suggest that the market quickly and substantially reacted to the increase in capacity by leading to a significant price convergence but then readjusted to a more moderate level, whose average is represented by the three €/MWh estimated above.

All in all, our results suggest that **around the divestitures there was a significant impact on German wholesale energy prices and both the short-run and long-run difference between peak and off-peak prices was significantly reduced, *ceteris paribus***. This finding is consistent with the Commission's decision effectively stopping or at least reducing E.ON's alleged abuse of market power. The exact extent of this convergence differs, depending on the assumption on the timing framework we consider relevant to observe these effects. However, the range seems to be quite large, but still reasonable and varies between 3 €/MWh to 15 €/MWh.

All proposed approaches have advantages and disadvantages. The short-run scenarios are possibly more intuitive because the short time window minimises the possibility that other unobserved factors or events create a bias. However, they might fail to measure long-term changes in the market structure or they might not capture slow adjustment in firms' bidding behaviour. They also cannot be interpreted as clean average treatment effects. The long-run effects, which can be better interpreted within a difference-in-difference framework, are more likely to capture permanent strategic adjustments in the bidding behaviour of both

74 We do not report the coefficient estimates for all control variables. However, they are all significant and conform to our expectations. Specifically, input prices and temperature are significantly and positively related to wholesale prices. The coefficients' estimates for the day and month dummies are also highly significant. Finally, the production capacity of wind and solar as well as the cross-border flows significantly decrease wholesale prices as expected. The full results are reported in Appendix A4.2.

incumbents and the smaller competitors. However, they could be contaminated by other policy intervention or market changes occurring during the same period. Indeed, during the years 2009-2011 several other national and EU-wide policy interventions affected the German electricity wholesale market. But the comparison of the different effects gives us a quite coherent picture that consistently points to an increase in competition in the market that can be related to the E.ON alleged abuse of dominance case.

6.4.7 Placebo analysis: the effect of the decision on the Spanish and French wholesale market

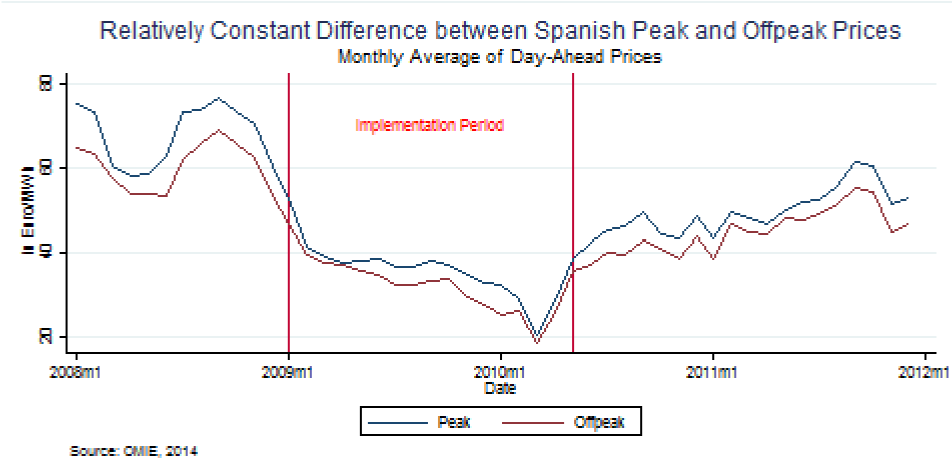
As discussed above to test the robustness of our findings, we conduct two ‘placebo’ tests, using data from Spain and France. These countries are similar to Germany along several dimensions (particularly size) and provide relatively good information on the main control variables, such as the production of renewable energy, cross-border electricity flows, holydays, and temperature. We then implement the same identification strategy used for Germany, comparing peak and off-peak prices and using the same definition of the before and after periods. The logic of the ‘placebo’ test is that: if we measure the effect of the E.ON decision and the different geographic markets are not strongly integrated, we should not see the same effects in the other countries that we observe for Germany.

Spain

During the sample period, the Spanish wholesale electricity market was not closely integrated to Germany. For one, Spain does not share borders with Germany, so there is essentially no-trade of electricity between the two. The effect of the E.ON alleged abuse case on the Spanish market would have only been possible if the German prices have significantly affected the French ones and these, in turn, affect the Spanish prices.[75] It is unlikely that the Commission’s decision significant affected Spanish prices.

Figure 6.16 shows the evolution of the monthly average peak and off peak Spanish wholesale energy prices. The differences between the two price series and their convergence appear much smaller than in Germany.

Figure 6.16 Spanish Monthly Peak vs. Off-Peak Prices



We then more precisely analyse the convergence patterns within our regression framework, reported in Table 6.4. Again, the model seems successful because we can explain more than 84 per cent of the variation in the Spanish wholesale prices. The difference between peak and off-peak prices in Spain seems to be much lower on average —around 1/3— than in Germany and ranges between six and 10 €/MWh. After 2009, similar to Germany, prices decreased on average eight to 19 €/MWh (the cumulative post-effect). But the convergence

75 During the sample period, the Spanish import and export of energy were almost exclusively with and towards Portugal. We therefore control for this cross-border exchange of energy by including the Portuguese wholesale prices.

between peak and off-peak prices was much smaller than in Germany: around 3 €/MWh as compared to the 15 €/MWh price convergence for Germany.[76]

Table 6.4 The Effect of the Divestitures on Spanish Wholesale Prices

	Post 2010 (1)	Post 2009 (2)	Short-Run (3)	Single Div. (4)
Peak	10.00*** (3.24)	9.52*** (2.68)	6.42*** (2.46)	6.61*** (2.50)
Peak × Post	-3.43*** (0.99)	-3.70*** (0.97)	-1.57 (2.01)	
Peak × Div. 1				-3.99*** (1.38)
Peak × Div. 2				-1.75 (1.07)
Peak × Div. 3				-1.14 (1..26)
Peak × Div. 4				-1.59 (1.66)
Peak × Div. 5				-0.67 (1.70)
Peak × Div. 6				
Peak × Div. 7				-2.31 (2.02)
Peak × Div. 8				-0.73 (2.79)
Constant	32.03*** (4.63)	31.28*** (4.20)	32.79*** (4.24)	33.61*** (4.27)
Cumulative post effect	-13.16* (6.95)	-19.61*** (4.58)	-8.1* (4.64)	-7.17 (5.01)
N	2,148	2,878	2,878	2,878
Adj. R2	0.8409	0.8439	0.8440	0.8432

The dependent variable is the daily average peak or off-peak price at the EEX power exchange. We control for input prices (gas, oil, coal, uranium, and emission), day, month, and year dummies, solar and wind energy production, cross-border production, market coupling, temperature, as well as holydays. Newey-West standard errors with maximum lag order of autocorrelation equal to seven days are reported in parentheses. The symbols ***, **, * represent significance at the 15, %%, 10% levels respectively.

This small but significant long-term convergence is consistent with the Spanish market becoming more competitive between 2009 and 2011, for different reasons. First, price convergence might have been determined by an increase of competition in the Spanish market due to the enforcement of other competition policy decisions. According to the data collected for the broad econometric analysis, several abuse cases were opened by the Spanish competition authority in the electricity sector after 2009.[77] Two EU merger cases affecting the Spanish electricity market were also cleared with remedies.[78] An alternative explanation relates to the general convergence of Central-West European wholesale electricity markets during the sample period, which might have increased the level of competition in each (e.g., Böckers and Heimeshoff (2014)). If *all* European markets are

76 Stretching these results, they might also be useful to improve our identification strategy in terms of a sort of difference-in-difference-in-difference approach. By looking at the difference in the convergence effects between Germany and Spain, we can identify the long-term level effect of the Commission's decision on the German market. This would be on average around 15-3=12 EUR MWh. Clearly, a more specific estimation that controls for cross-countries differences would be needed to confirm the validity of this back-of-the-envelope calculation.

77 The cases were: S/0211/09, ENDESA INSTALACIÓN, S/0243/10 IBERDROLA/ SUMINISTRO AYUN, S/0255/10 PUNTOS SERVICIO EON, S/0268/10 PUNTOS SUMINISTRO IBERDRO, S/0319/10 ACOGEN, S/0361/11 GAS NATURAL COMERCIAL, S/0328/11 TGSS, S/0450/12 CONVENIOS AYUNTAMIENTOS G.

78 The cases were: M.5978 GDF SUEZ/INTERNATIONAL POWER, and M.5467 RWE/ESSENT.

indeed well integrated, then the observed effect could also be attributed to the specific E.ON decision.

Looking at the short-term effects might be particularly useful to better differentiate between these alternative explanations and support our identification strategy for Germany. While other factors might have affected the convergence between peak and off-peak prices in Spain over one or two years as measured by the long-term effects, it is much less likely that Spanish prices are significantly affected when we look at one week around each individual divestitures, as we do in the short-run scenarios. In this case, we could potentially observe significant results either because the divestiture dummies measure other shocks that affected energy markets unrelated to the E.ON case, i.e., we wrongly identified the divestiture period, or because German and Spanish markets are strongly integrated.

As expected, there is no significant convergence effect in either short-term specifications. First, the short-run effect (column three) is not significantly different from zero. Second, almost each of the single divestitures' estimates is not significantly different from zero. So that while German prices significantly react to the implementation of the remedies, Spanish prices remain mostly unaffected.

Overall, the Spanish results substantiate our claim that we are able to identify, even imperfectly, the effect of the implementation of the remedies imposed by the Commission on E.ON and we are not measuring unrelated shocks affecting electricity markets.

France

Compared to Spain, the French wholesale electricity market is much more integrated with Germany. The two countries share a border and the trade of electricity was small but not negligible during the sample period. Germany is the main importer and exporter of French electricity.[79] In our main specifications, we try to control for these cross-border electricity flows. It's reasonable to expect that a decision significantly impacting German wholesale prices might also have significant consequences for the French market if prices are related.[80] So our expectation is that the Commission's decision could have had some significant effects on the French prices but these effects should be significantly lower than those in Germany. Figure 6.17 reports the evolution of the monthly average peak and off-peak French wholesale energy prices.

The picture seems more similar to the German market, however, 2009 is unusual, particularly because of a huge price peak in the autumn. While there is some price convergence, prices seem to drift apart during 2011. Again, to more precisely analyse the convergence patterns we use our regression framework, reported in Table 6.5.

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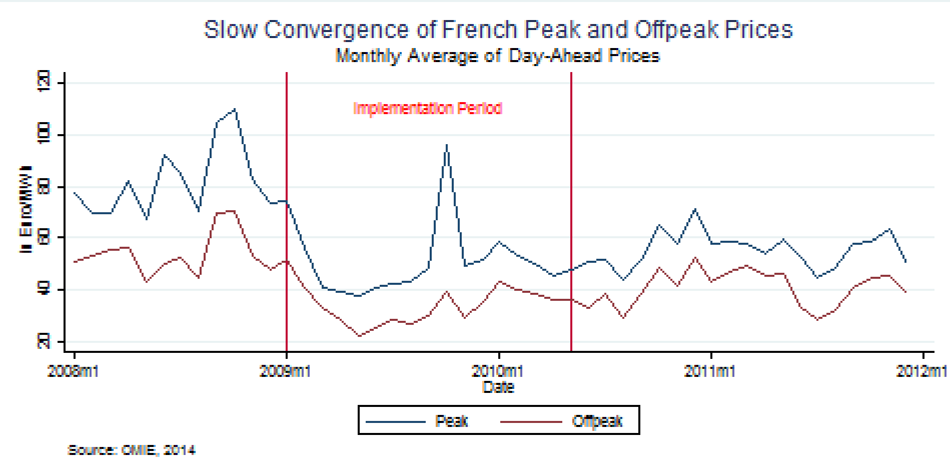
79 For instance in 2009, the interconnection capacities between France and Germany represent ca 25% of the total interconnection capacities between France and its 6 neighbouring countries. Specifically, Germany accounts for about 2.5%of the installed generation capacities in France in terms of exports and 2.1% in terms of import. In terms of cross-flows, Germany was the largest importer (7.2 TWh) and exporter (19.2 TWh) of electricity capacity from and to France (CRE, 2010).

80 In its yearly report for 2010, the Commission de la Régulation de l'Énergie (CRE) mentioned (CRE, 2010, p.1, p.4): "Overall the monthly changes of the net trade balances at the borders are correlated with the changes in price differentials, with this correlation being particularly clear with Germany and the UK (Graph 5): the trade balances observed on all of the borders are consistent with the direction of the average price differentials with France (Day-ahead, base)."

Figure 6.17 French Monthly Peak vs. Off-Peak Prices



The results partially correspond to our expectations. The difference between peak and off-peak prices is estimated on average between 21 and 30 €/MWh and between 2009 and 2011, all prices decreased on average by 33 to 50 €/MWh (the cumulative post-effect). These estimates are even larger than those from Germany. The convergence between peak and off-peak prices during the same period appears to be similar to Germany and on average around 15 €/MWh. But if we exclude 2009 from the analysis, there is no significant convergence between 2010 and 2011. This suggests that France experienced some significant shocks during 2009 that influenced the convergence between peak and off-peak, which disappeared in the following years.[81]

These results are quite different than those from Spain and Germany because they highlight that 2009, the year during which most of the E.ON divestitures took place, was an unusual year for France. Accordingly, it might be more difficult than for Germany or Spain to clearly identify the effect, or otherwise, caused by implementing the remedies.

The short-run convergence effects show a positive, though not significant, effect of the divestitures in both specifications: the difference between peak and off-peak prices increased around the divestitures. But in both cases, the standard errors are estimated to be extremely large, making these effects not significantly different from zero, meaning no clear pattern can be identified in the data. Looking at the convergence results in the week around the single divestitures, there are some negative and some positive effects, some of which are significant. Again, no clear pattern emerges because only one of the individual divestiture's effects meets the estimations for Germany.

Table 6.5 The Effect of the Divestitures on French Wholesale Prices

	Post 2010 (1)	Post 2009 (2)	Short-Run (3)	Single Div. (4)
Peak	29.08***	30.84***	21.06***	26.01***

81 In its yearly report for 2010, CRE mentioned that (CRE, 2010, p.1, p.4): "The wholesale energy markets were characterised early 2009 by sharp decreases in electricity and gas prices in the wake of a generalised decrease in other fuels (oil, coal) and emission quotas prices. This evolution occurred against the backdrop of the financial crisis and the resulting recession. […] On the electricity market, there have been some price fluctuations. In particular, a price spike occurred in October 2009 when the sales offers on the Spot market were unable to meet the purchase offers over a period of four hours during which the price was €3,000/MWh, which is the technical ceiling of the EPEX Spot market. A smaller price spike was also seen in January 2010. […] 2009 also showed a sharp drop in the French electricity net export balance. This deterioration in the exchange balance was mainly due to the particularly low availability of nuclear facilities during this period. […] The comparison of EDF marginal costs and Spot prices from the EPEX auction shows that, for the periods of time when EDF Trading was assumed to be marginal, the price-cost difference in 2009 was 6.5% on average. Excluding data of 19 October 2009 price spike and the sometimes negative occurrences of the optimisation models, the price-cost difference for 2009 was 3.3%. On the basis of these results CRE considers that, for 2009, the Spread between prices and marginal costs is at levels that do not represent abuse of a dominant position."

	Post 2010	Post 2009	Short-Run	Single Div.
	(1)	(2)	(3)	(4)
	(2.82)	(2.80)	(3.68)	(2.79)
Peak × Post	0.00	-15.34***	16.38	
	(1.56)	(1.94)	(18.13)	
Peak × Div. 1				-5.05
				(4.53)
Peak × Div. 2				-9.11***
				(2.60)
Peak × Div. 3				-6.74**
				(2.96)
Peak × Div. 4				152.56
				(99.07)
Peak × Div. 5				5.54***
				(1.98)
Peak × Div. 6				-4.22
				(2.62)
Peak × Div. 7				-2.35*
				(1.21)
Peak × Div. 8				-3.58
				(2.87)
Constant	23.40***	20.31***	24.42***	30.20***
	(4.46)	(4.43)	(5.35)	(4.17)
Cumulative post effect (long run)	-35.18***	-33.87***	-57.03***	-54.50***
	(8.72)	(9.14)	(10.89)	(9.57)
N	2188	2916	2916	2916
Adj. R2	0.4482	0.4014	0.4445	0.5071

The dependent variable is the daily average peak or off-peak price for France. We control for input prices (gas, oil, coal, uranium, and emission), day, month, and year dummies, cross-border production, market coupling, temperature, as well as holydays. Newey-West standard errors with maximum lag order of autocorrelation equal to seven days are reported in parentheses. The symbols ***, **, * represent significance at the 15, %%, 10% levels respectively.

In conclusion, the picture for France is mixed. Overall, the model does not perform as well as the estimations for Germany and Spain. The adjusted R-squared is between 0.4 and 0.5, meaning we can only explain less than half of the variation in French wholesale tariffs. Few results are similar to those observed for Germany, while others differ significantly. Specifically, both the cumulative divestiture effects and the long run picture differ quite substantially from the German analysis, although one of the short-term effects seems to be in line with that from Germany. Generally, the integration between the German and the French market is not as extreme as the short-term changes in German prices are matched by the French ones. Although less clear cut than for Spain, the French analysis also supports our identification strategy.

6.4.8 Robustness checks: High-frequency data and the autocorrelation in the error terms

Autocorrelation in the residuals is one of the main econometric issues we face by having high frequency, time-series data. The use of a Newey-West estimator for the standard errors should clearly tackle this issue. However, we try different specifications to understand the extent of the potential problem.

Lower order autocorrelation: First, we use a Newey-West estimator with lower order autocorrelation lag (two days). We report our findings in Annex 4. Results are almost identical to those reported in our main specification, although we lose some significance in the short-term scenario. Hence, controlling for a higher order autocorrelation actually reinforce our results.

Bootstrapped standard errors: Second, we use a bootstrap estimation with 1,000 replacements to obtained bootstrapped standard errors.[82] We report our findings in the appendix in Figure 6.13. Results are again very similar to those reported in our main specification, although standard errors tend to be slightly larger in all specifications and, therefore, less significant.

Weekly data: Third, we reduce the frequency of the data and use weekly averages for the peak and off-peak prices. Results are again reported in the appendix in Table 5.14. Also in this case, our qualitative and quantitative results are the same. We observe significant long-term effects for Germany in the range of 15 €/MWh and significant short- term convergence effects around the divestitures similar in magnitude to those observed in the main specification.

6.5 Econometric analysis of the retail market

We now analyse the effect of the Commission's decision on retail prices. The methodological approach is similar to that adopted for the wholesale analysis in that we use a DiD methodology and a hedonic price equation. However, the data, their level of aggregation, and the identification strategy differ substantially. Specifically, the entire analysis is focused on exploiting regional variation in retail tariffs within Germany, across different firms, and over time.

6.5.1 The data

The main data source for the analysis of retail prices is the German price comparison site Verivox, which provided detailed and highly disaggregated data on energy retail prices, specifically, monthly price data between January 2007 and August 2014 for 8,241 different zip codes (located in 6,249 cities across all 16 German states) from 841 different electricity providers.

For each zip code and month, we have the price for three types of household consumption (differentiated by yearly energy consumption: 1,500 kWh, 2,800 kWh, 4,000 kWh) and one typical commercial costumer (10,000 kWh). For each zip code and month, we also know the incumbent provider's baseline tariff ('Grundversorgungstarif'), the incumbent provider's cheapest offer, and the overall cheapest offer for that particular regional market. Overall, we have 12 different prices for each area and time period.

In Table 6.6, we present summary statistics related to the Verivox prices. Average tariffs substantially vary both within and across consumer groups. The baseline tariff constitutes the highest price in a given market. Therefore, we can infer the lower and upper bound of the distribution of retail prices. These bounds are used to define the variable 'price dispersion' which represents the difference between the cheapest and the most expensive tariff in each zip code and period. For example, over the entire sample period, the average lowest price for a typical household with two children (2800 kWh per year) would have been €536.6 while the average annual baseline tariff would have €675.8. On average over all areas and time periods, such a representative household could been have saved €139.2 per year (more than 20 per cent) by switching from the baseline tariff to the cheapest tariff.

[82] Bootstrapping is a nonparametric econometric approach based on random re-sampling and used to obtain an approximated distribution for relevant statistics (e.g., standard errors, confidence intervals, p-values, test statistics). It is particularly helpful when the researcher does not clearly know the theoretical distribution of the chosen test statistic. The bootstrap command in Stata repeatedly draws samples with replacement from the original sample. For each of this sample, we run an OLS regression with White heteroskedastic robust standard errors. The bootstrapped standard errors are then calculated as the sample standard deviation of the sampling distribution (Guan, 200 able 6.63).

Table 6.6 The German energy retail market – Average prices for different consumption categories – January 2007 to December 2012

	1,500 kWh	2,800 kWh	4,000 kWh	10,000 kWh
Baseline tariff	402.8	675.8	927.8	2274.9
	(36.73)	(63.15)	(88.75)	(252.7)
Cheapest incumbent tariff	371.3	633.7	871.6	2162.8
	(36.66)	(56.65)	(77.54)	(214.6)
Cheapest tariff	294.1	536.6	754.3	1917.7
	(25.14)	(29.05)	(41.85)	(131.9)
Price dispersion	108.7	139.2	173.5	357.2
	(49.62)	(60.34)	(74.16)	(186.5)

*Standard deviation in parentheses.

In Table 6.7, we report how frequently each of the different firms is observed to be an incumbent retailer and how often each of the different firms is the retailer offering the lowest local tariff. E.ON is by far the largest incumbent energy retailer in terms of local network areas operated, being the main provider in 25 per cent of the German zip codes. RWE, Vattenfall and EnBW are incumbents in 15.7 per cent, 3 per cent and 9.7per cent of zip codes respectively, while municipal providers are incumbents in 16.8 per cent of areas. Independent retailers only account for 2.2 per cent of incumbents.[83] This picture drastically changes when we instead consider how often each firm offers the lowest electricity tariff: In 38.6 per cent of areas the lowest tariff is provided by independent retailers while E.ON, RWE and EnBW practically never offer the best price.[84]

Table 6.7 The German energy retail market – Incumbent retailers – January 2007 to December 2012

	Incumbent Tariff		Cheapest Tariff	
	Mean	St. Dev.	Mean	St. Dev.
E.ON	0.248	0.432	0.001	0.023
RWE	0.157	0.364	0.001	0.027
EnBW	0.097	0.295	0.003	0.051
Vattenfall	0.030	0.169	0.085	0.279
Municipal provider (Stadtwerke)	0.168	0.374	0.102	0.303
Independent retailer	0.022	0.147	0.386	0.487
Other	0.278	0.448	0.422	0.494

We represent the average price evolution of the three different tariff types, i.e. incumbent's baseline tariff, incumbent's lowest tariff, overall lowest tariff, and the price dispersion for the different consumption plans respectively in Figure 6.18-Figure 6.21. We differentiate between local markets served by one of the big four players, local markets served by

83 Our definition of independent players is rather demanding and based on the name of each firm. Firms that have "E.ON", "RWE", EnBW", "Vattenfall", or "Stadtwerk" in their name are first assigned to their respective category. We then researched the ownership structure of all remaining firms. We defined as truly "independent" only those firms that are neither directly nor indirectly controlled by one of the big players or a municipal provider. The remaining 28% of incumbents are defined as "other". They have a dispersed ownership and are mostly jointly owned by one or more of the big players and/or municipal utility providers and/or other firms.

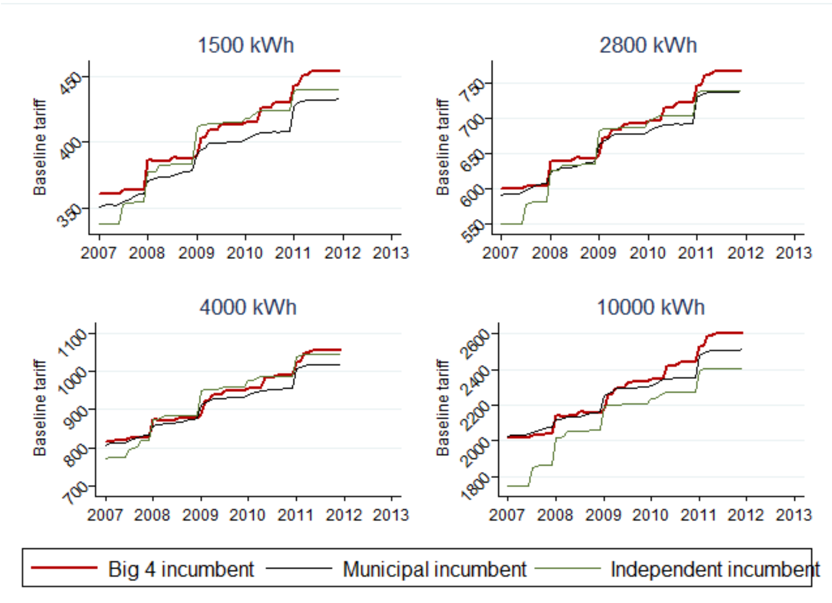
84 In line with considerations on consumer switching behaviour presented above, the local incumbent is very unlikely to offer the most competitive tariff: only in 1.5% of our observations the best tariff offered by the incumbent constitutes the cheapest tariff available.

municipal providers, and local markets served by independent retailers.[85] These figures aim to identify tariffs' trends across different retailers.

First, all prices exhibit an increasing trend over the sample period. This might be surprising given that wholesale prices substantially decreased during the sample period. Yet as discussed in Section 5.1, the increase in retail tariffs is mostly due to a substantial increase in taxes, fees, and network charges. Changes in wholesale prices also pass through to retail market slowly because energy is bought by retailers via long-term contracts spanning several years. Finally, retail prices are also influenced by the extent of market power downstream. Indeed, the increasing retail prices' trend is much stronger for the baseline tariff, medium for the cheapest tariff of the incumbent, and lowest for the cheapest overall tariff in the market. This is consistent with our expectation that market segments that are less competitive due to the substantial consumers switching costs (i.e., the incumbent tariffs) experience higher price increases over time. We also see that the price dispersion significantly increased during the sample period.

Prices within the different categories seem to follow similar patterns across firms' types and consumption plans i.e., they show a common trend. Yet, some differences emerge. Specifically, the lowest baseline tariffs for household customers, particularly those with low consumption: 1,500 and 2,800 kWh, and small business customers are offered either by municipal providers or independent firms during most of the sample period. A similar, although perhaps less marked, picture emerges for the lowest incumbent tariffs. The overall lowest tariffs show larger variation in prices than the other two types of tariffs. Typically, the lowest tariff is offered by independent providers. Yet again, the size and significance of those differences and their evolution over time can only be confirmed through a more rigorous econometric approach that should help cleanly identify the drivers of these price dynamics.

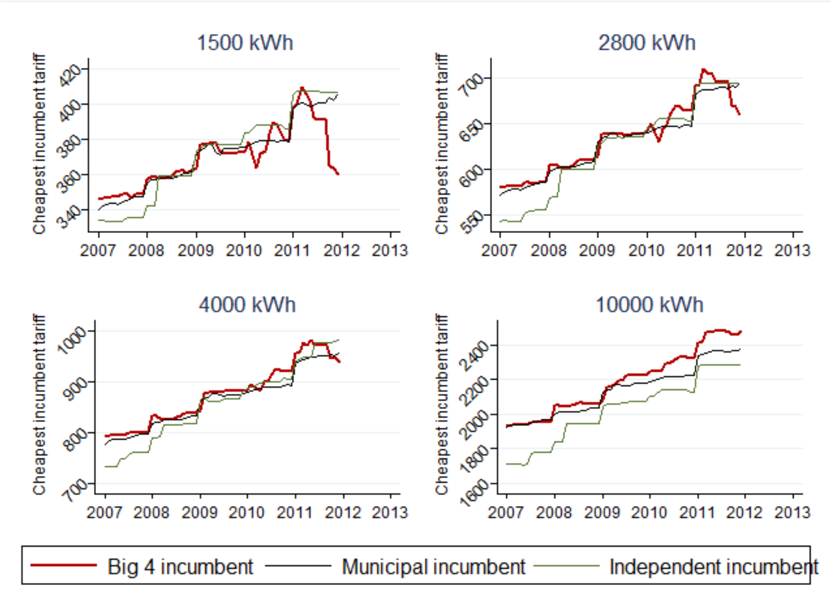
Figure 6.18 The yearly incumbent's baseline tariff – January 2007 to December 2012



Source: Own calculations based on Verivox Data

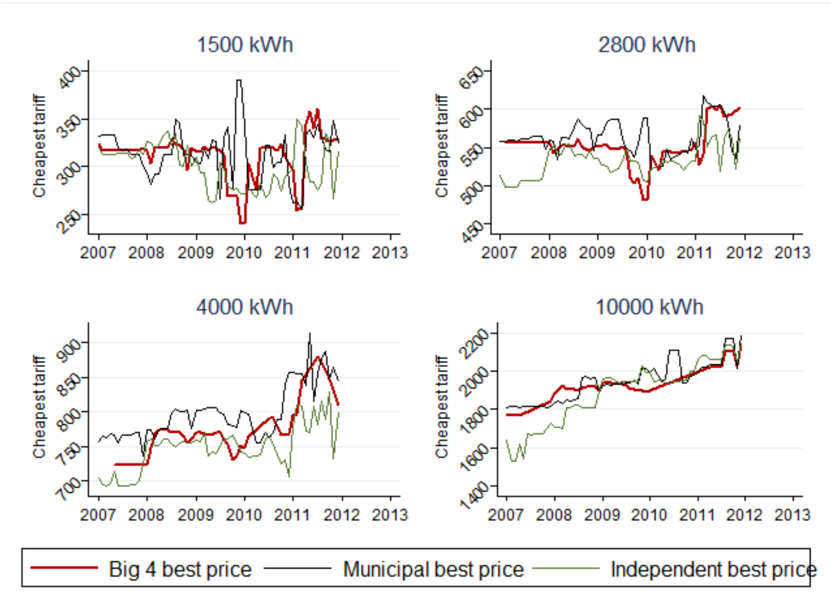
85 Note that the figure for the 'big four' averages out heterogeneous firms: While E.ON, RWE and (at least partially) EnBW are big German firms which share many structural similarities, Vattenfall is a Swedish multi-product firm that entered the German market only in the late 1990s.

Figure 6.19 The yearly incumbent's lowest tariff – January 2007 to December 2012



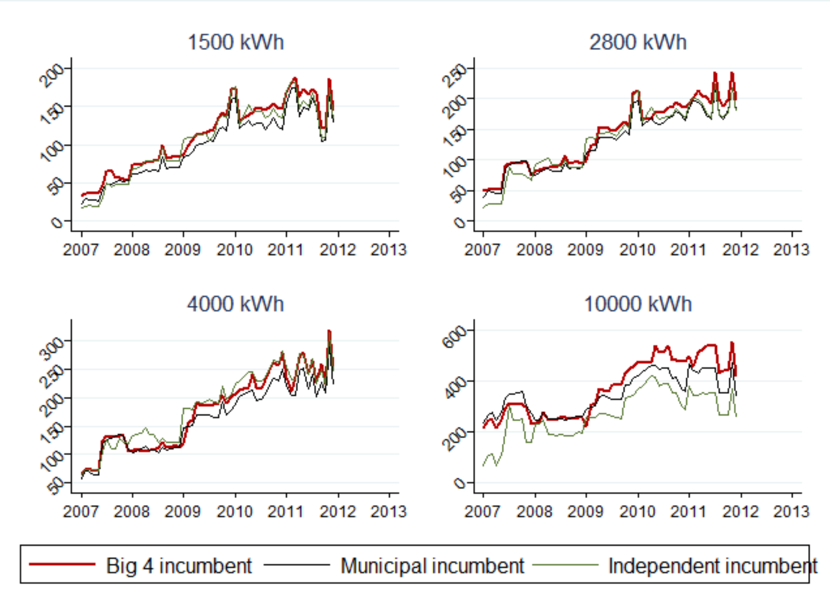
Source: Own calculations based on Verivox Data

Figure 6.20 The overall yearly lowest tariff in the regional market – January 2007 to December 2012



Source: Our calculations based on Verivox Data

Figure 6.21 Price dispersion – January 2007 to December 2012



Source: Our calculations based on Verivox Data

Additional data

In addition to the Verivox pricing data, we use other datasets to control for demand and supply shifters that should explain some of the observed regional and time variation in retail tariffs. Specifically, we add information on local population structure and the number of energy-intensive plants (demand shifters), plus data on grid capacity and firms active in the energy sector (supply shifters).

The data on local population structure are obtained from Regionalatlas Deutschland provided by the German Statistical Office.[86] The data discern more than 400 'Kreise' (rural areas) and cities in Germany, each containing an average of 19 zip codes. To control for regional demand variations, we include control variables indicating the local population density (inhabitants per square kilometre), the difference between the local birth-rate and death-rate, and the local share of non-German population. In addition, the European Commission provided a list of 145 energy-intensive industrial plants (EIP) active in Germany, likely to affect local energy demand.[87] We assign these plants to their respective zip codes and use the number of local EIPs as an additional demand control variable. Data on local grid capacities and 'Netznutzungsentgelte' (network usage fees, i.e. the fees the network operators charge firms for power transmission) were provided by Ene't GmbH (e.g., Nikogosian and Veith (2012)).[88] As an additional supply side control variable we use the Amadeus database to identify the total number of energy firms headquartered in each zip code.

6.5.2 The basic econometric model

The basic empirical model for the downstream analysis consists of estimating a hedonic price equation of the following form:[89]

$$p_{irt} = \propto + \beta_i treat_{ir} + \delta post + \gamma_i treat_{ir} \times post + X_{rt} + \mu_{ir} + \tau_t + \varepsilon_{irt}$$

86 https://www.destatis.de/onlineatlas/

87 An energy intensive industrial plant is defined as a Non-power sector installation with an Emission Trading System's Permit according to the European Union Transaction Log database.

88 http://www.enet.eu

89 We will separately analyse the price for different consumption plans: three typical household types as well as a typical business costumer type.

Where the tariff set by retailer *i* in region *r* at time *t* is a function of market demand and supply drivers (X_{rt}), firm-region-specific fixed-effects to account for time-invariant unobserved heterogeneity across regions, as well as time fixed-effects to account for firm/region/ or firm-region invariant unobserved heterogeneity. The error term ε_{irt} is assumed to be heteroskedastic and correlated among observation in the same regional market.[90] The dummy $treat_{ir}$ is equal to one for the firms/region/outcomes that can be expected to be more affected by the upstream conduct and zero otherwise (e.g., Hasting, 2004, Aguzzoni et al. (2015)). The dummy $post$ is equal to one for the post conduct period. In the following section we will thoroughly discuss the definition of these two crucial variables.

The key variable of interest is the interaction between *post* and *treat*, whose coefficient (γ_i) measures the price change in the treated regions (or firms in a given region) relative to the price change in non-treated regions: the average treatment effect (ATE). This coefficient quantifies the additional variation experienced by the prices of those retailers less affected by the Commission's decision with respect to the average price change for those firms that were more affected. This coefficient is firm-specific to account for the possibility of firm-specific heterogeneous effects for different firms. The post coefficient (δ) measures any price change (between the pre-abuse and the post-abuse period) common to all firms and regions, while the coefficient β_i accounts for any idiosyncrasies between treated firms/regions and non-treated ones unrelated to the alleged abuse.

6.5.3 Identification

The two key elements of our identification strategy are the definition of the treated and control groups (*treat$_{ir}$)* and the definition of the before and after periods (*post)*. The identification hinges on the institutional details of the German electricity market. As a first step in our strategy, we discuss some of these issues in more detail. Specifically, two main elements play a crucial role for the identification strategy. First, we consider the heterogeneity among the different retailers in the German energy producers, as well as the different energy purchasing strategies, which is closely related to the length of the contracts stipulated with wholesale energy suppliers.

As described in the introduction to this chapter, there are different types of firms active in the German retail markets. A first group of retailers is represented by the four big vertically integrated operators: E.ON, RWE, EnBW, and Vattenfall. These are very large multi-product energy firms, mostly active at all levels of the vertical chain. They are the major incumbents both in wholesale and in retail markets and own a substantial part of the transmission and distribution networks. Yet, their operations at these different levels have been legally separated since 2002. Among the four operators, only Vattenfall is different since it is not a long-term incumbent in the German market. Vattenfall is a Swedish utility that entered the German (and other European) market(s) on a massive scale in the late 1990s.

The big three German companies account for ca. 50 per cent of the German retail market in terms of national market shares. They all have a strong regional focus: E.ON is particularly strong in the south (Bavaria) and east of Germany; RWE is the main incumbent in the west (particularly North-Rhine Westphalia), and EnBW is the main operator in the south-west (Baden-Württemberg). While there were some dynamics in their market shares, they maintained a dominant position over the entire sample period. Vattenfall is particularly strong in two major city-states (Berlin and Hamburg) and its national market shares remained above 10 per cent during the sample period as well. These retailers generally offer nation-wide tariffs even though there is some cross-regional variation, particularly across their cheapest tariffs.

The other relevant players in the German energy markets are the many municipal infrastructure utilities ('Stadtwerke'). These firms are also often vertically integrated and, in most cases, they are multi-utilities, active in electricity and also in other sectors such as gas, water, sewerage, municipal waste, etc. They mostly produce energy for their own needs and

[90] Also in this case we perform one robustness check to test the relevance of this assumption.

not for sale in the wholesale markets. They have a very strong local (political) connection and identity. While they are characterised by heterogeneous governance structures, they are very often publicly owned or at least they are closely aligned to local politics.

Several commentators mention that these firms might pursue quite different objectives than for-profit energy companies because of their political mandate. They are therefore likely to behave very differently to both the established big four incumbents and the smaller, independent entrants that mostly focus on electricity retail. Given their large number and the governance heterogeneity of different municipal firms, their pricing behaviour is also heterogeneous. The regional scope of their operations is also reflected in a cross-regional variation in their tariffs.

The third category of firms active in retail electricity markets is made up of many smaller, independent entrants. They are mainly small retailers that are not vertically integrated. The majority are partially owned by the big four or by the municipal firms, but there is also a substantial number of truly independent companies, with a very different market strategy based on their structural difference to the other operators in the market. They are small, their capital is limited, and they target their operations mostly at a regional base and to a specific group of well-informed and mobile customers.

Besides different levels of vertical integration, size, and possibly objectives, these groups of firms seem to have a very heterogeneous purchasing strategy in wholesale markets. In its monitoring report in 2011, the German regulator mentions that (Bundesnetzagentur (2011) p41): '[…] *looking at the purchasing strategies of different [retail] energy suppliers it can be seen that new entrants currently purchase energy at a much shorter term than the established incumbents. For instance, new entrants order on average only 20 per cent of their sales volumes more than one year before its delivery to the end costumers and ca. 35 per cent during the year of the delivery. On the contrary, incumbents order more than 40 per cent of their sales volumes more than one year in advance and only ca. 5 per cent in the year of the delivery. Since a short-term purchasing strategy is currently on average cheaper than a long-term one, new entrant can offer at present more convenient conditions to their customers without losing money in supply and distribution.'*

Finally, as mentioned above, the very low levels of switching among households customers implies that incumbent firms, and particularly especially E.ON, RWE and EnBW, have substantial market power over their captive customers.

These considerations highlight the logic of our identification strategy. We expect large, vertically integrated incumbents - i.e., the big four - to behave differently than the small independent incumbents and, potentially, the municipal utilities. Specifically, we expect the three big large firms and, potentially also Vattenfall, to react less strongly to changes in wholesale prices than small, independent providers. Mainly because they have a larger degree of market power over their customers and use a less aggressive and more conservative purchasing strategy in wholesale markets, probably because they are vertically integrated. Given that the prediction for municipal firms and other firms with a mixed ownership structure is unclear, we will not include them in the control group but will presume that they are also treated. Therefore, we will estimate firm-specific heterogeneous treatment effect that might be different for the two groups of firms

Treatment

Our treatment group consists of E.ON, RWE, EnBW and potentially Vattenfall, which is expected to react less to changes in wholesale prices than independent incumbents. Therefore, their prices are expected to increase relative to the control group of small, independent retailers in the post-treatment period. Municipalities and other firms should react differently than independent retailers, therefore they are assumed to be differently treated.

To increase the power of our identification strategy, we then consider the heterogeneity of response according to the market segments. The existence of high consumers switching costs implies that many of the German households are captive customers of the incumbent firms. Yet, a small but increasing proportion of households seem to have better information about the benefit of switching suppliers and began to use it. . We can therefore consider that the German retail electricity market is somehow segmented between a group of captive customers who stick to the incumbent base-line tariff – or perhaps another cheaper tariff of the incumbent - and a more mobile group of customers willing to switch. The latter market segment is probably more competitive, meaning the tariffs in this segment of the market should be more responsive to changes in wholesale prices. Therefore, looking at the price dispersion among the highest incumbent baseline tariff and the overall cheapest tariff in the same regional market allows us to strengthen our identification.

Additional Treatment

We expect the price dispersion at the local market to significantly increase post-treatment in markets where E.ON, RWE, EnBW and potentially Vattenfall are the incumbent operators.

To clearly identify the impact of an upstream change in wholesale electricity prices on retail tariffs, we use another important characteristic of electricity markets. As discussed in the introduction, energy purchase works via long-term contracts. This implies that any change in wholesale prices should materialise in retail markets only with a substantial delay. The German regulator mentions (Bundesnetzagentur (2011) p41): *"[…] the wholesale prices, which have been decreasing since the second half of 2008, started to have a positive effect on household retail prices in 2010. However, [these price reductions] are considerably delayed if compared to the wholesale market. The main reason for these delayed reductions of the suppliers' acquisition costs lies on the long-term purchasing strategy".*

In the wholesale analysis, the effect of the Commission's decision on wholesale prices was quite short-term and materialised soon after the individual remedies were implemented. However, as discussed above, we would expect a corresponding decrease in retail prices at the earliest several months after the enforcement of the intervention. The decrease in retail tariffs should be moderated by the fact that different retailers use different purchasing strategies, described above. Looking at time-varying treatment effects should therefore help us to better identify the effect of the Commission's decision on retail tariffs.

Heterogeneous Treatment

We expect the effect of the Commission's decision to slowly materialise over time after the implementation of the remedies.

6.5.4 Main Results

In this section, we report the results for the different specifications and outcome variables. We begin with the regressions on the less competitive tariffs, i.e. the incumbent's baseline tariffs (Table 6.8) and move to the most competitive ones, i.e. the overall cheapest tariffs (Table 6.9). We finally analyse a measure of price dispersion defined as the difference between the highest and the lowest tariff observed in a given local network area (Table 6.10).

The Adjusted R-squared of more than 90 per cent in all specifications shows that our model well explains the data. This is very important since it means that we could control for most of the relevant drivers of retail prices and account for most of the cross-sectional variation across regions. This creates additional confidence that omitted variable bias should not be a major endogeneity issue in our context, which reinforces our identification strategy. Some of the control variables are also significant and have a positive impact on prices (Pop. Density, Share Foreign and, partially, the number of firms located in the regional market), while population growth (Births-death) significantly reduces all tariffs. Finally, results related to the number of energy intensive plants (EIP) suggest that their presence is, if at all, only weakly negatively related to customers' households and small business customers' tariffs.[91]

[91] We added this control variable to account for potential important differences in the production and economic structure of the areas. Specifically, there may be economies of scale in the distribution of electricity, leading to lower prices in areas where EIP are present. Yet, the presence of EIP does not necessarily reflect the effects of long-term contracts in the households' retail energy market since this represents a completely different

Looking at the firm-level effects over the entire sample period (the firms' dummies), RWE and EnBW seem to offer baseline tariffs for households customers, which for some profiles are significantly higher than the reference group of independents, while Vattenfall and, partially, E.ON offer baseline tariffs which for some segments, are significantly lower.

Table 6.8 Incumbent's Baseline Tariff

	1,500 kWh		2,800 kWh		4,000 kWh		10,000 kWh	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
E.ON	-1.533	(3.941)	-1.991	(6.699)	1.606	(10.84)	-75.39*	(42.74)
RWE	-1.580	(3.436)	-0.539	(5.501)	21.38**	(9.612)	-14.66	(27.06)
EnBW	0.740	(9.060)	10.34	(9.469)	39.74***	(12.00)	312.7***	(48.37)
Vattenfall	-18.52***	(3.331)	-36.74***	(5.391)			-144.3***	(26.86)
Stadtwerke	0.179	(3.032)	-2.710	(5.108)	-0.105	(8.894)	-13.11	(26.19)
Other	5.821*	(3.321)	8.565	(5.365)	16.24*	(9.581)	0.507	(26.80)
E.ON × Post	5.512***	(1.118)	9.352***	(1.904)	2.192	(2.025)	39.84***	(7.955)
RWE × Post	7.760***	(1.113)	17.34***	(1.905)	15.96***	(2.023)	64.35***	(8.034)
EnBW × Post	0.143	(1.101)	3.560*	(1.884)	-3.667*	(2.005)	27.32***	(7.888)
Vattenfall × Post	-0.287	(1.235)	1.490	(2.123)	-27.02***	(2.010)	92.45***	(8.135)
Stadtwerke × Post	-5.849***	(1.141)	-9.910***	(1.948)	-21.52***	(2.095)	-32.68***	(8.213)
Other × Post	-0.111	(1.129)	-2.020	(1.922)	-17.93***	(2.126)	-12.60	(8.005)
# of EIPs	-4.180*	(2.447)	-6.468*	(3.823)	-7.317	(4.997)	-54.18*	(31.41)
Pop. Density	0.008***	(0.002)	0.016***	(0.002)	0.019***	(0.003)	0.046***	(0.008)
Share foreign	0.203	(0.159)	0.730**	(0.288)	1.556***	(0.410)	3.436***	(1.050)
Births-deaths	-0.095***	(0.009)	-0.130***	(0.014)	-0.213***	(0.019)	-0.330***	(0.052)
# Amadeus firms	0.094*	(0.051)	0.089	(0.085)	0.069	(0.131)	0.086	(0.321)
Constant	346.7***	(3.424)	573.8***	(5.510)	774.5***	(8.980)	1937.3***	(28.29)
Observations	480,496		480,496		482,231		479,906	
Adjusted R-squared	0.915		0.922		0.919		0.928	

The dependent variable is the price a costumer using the different consumption plans (1,500 kWh, 2,800 kWh, 4,000 kWh, and 10,000 kWh per year) would pay if she chose the incumbent's baseline tariff. The control category for the firm-type dummies is the group of independent firms. We control for 8,208 zip-code fixed effects as well as 60 month fixed-effects. The entire implementation period (the year 2009) is excluded from the regressions. Standard errors are clustered at the zip-code level. *t* statistics in parentheses. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

More interesting for our identification strategy are the coefficients estimates of the interaction between the firms' dummies and the dummy for the post-intervention period which takes on the value of 1 after May 1 2010. These estimates measure the differential post-treatment trend for the tariffs of the different firms' types compared to independent incumbents. As mentioned above, we expect the vertically integrated (though legally separated) big four incumbents to react less swiftly to changes in wholesale prices than other firms and, in particular, with respect to small non-integrated, independent incumbent retailers.

Consistent with this expectation, E.ON, RWE and, to a lesser extent, EnBW and Vattenfall have significantly increased their tariffs post-intervention with respect to those firms likely to more easily pass through lower wholesale prices. This result can also be described as: **other**

product market than the market for large industrial plants. In the few regressions where the coefficient estimate is significant, it is negative. The presence of energy intensive plants (EIP) is weakly negatively related to lower baseline tariffs of incumbent firms both to household customers and small business customer in case of the baseline tariff of the incumbent as well as in the case of the cheapest tariffs in a region. Yet, it is not significantly related to price dispersion within a region.

firms significantly reduced their tariffs after the implementation of the Commission's decision as compared to the big three. As stressed above, it is important to note that all retail baseline tariffs significantly increased over time. Our result suggests that the tariffs of small incumbents and municipalities would have increased even more had the wholesale prices not decreased following the implementation of the Commission's decision.

The size of the coefficients' estimates is heterogeneous across firms and across consumption plans, but seems to be non-negligible. For instance, the price increase for E.ON with respect to the independent incumbents in the 1,500 kWh consumption plan is 5.512 € per year which represents 1.5 per cent of the average conditional annual expenses for that consumption plan, represented by the constant (346.7 €). Interestingly, the municipal firms, or 'Stadtwerke', seem to have reacted even more extremely than the (few) independent incumbents. Their baseline tariffs have significantly decreased with respect to that of the independent incumbent retailers and, clearly, to those of E.ON, RWE, EnBW, and Vattenfall. In the case of 1,500 kWh consumption plan, the price reduction post intervention compared to independent firms is by 5.85 € per year and it represents ca. 1.7 per cent of the annual bill. Compared to E.ON, the reduction of the 'Stadtwerke' is therefore ca. 11 € and accounts for more than 3 per cent of the annual bill. These findings are consistent across different consumption plans and are even stronger for RWE.

Our interpretation is that **the reduction of wholesale prices potentially spurred by the Commission's decision has been differently passed on to final customers by the different firms' types as expected**. But we suggest a cautious interpretation of our results in terms of demonstrating a causal relationship between the Commission's decision and the outcome in retail markets. Clearly, several other interventions have affected the working of wholesale markets during this period such as the national Sector Inquiry of energy production and distribution run by the German cartel office ('Bundeskartellamt') around 2009. As suggested above, there might be several channels to explain why big integrated players might have adjusted their prices differently than independent or smaller firms. However, our empirical evidence is surely consistent with the claim that **the Commission's decision, by reducing market power - and prices upstream - might have also contributed to reducing prices downstream.**

Focusing on the incumbent tariffs is clearly important because more than 70 per cent of German households were still served by incumbent firms during the sample periods. But it is also important to understand the price dynamics of the most competitive segment of the market, represented by the cheapest tariffs. Focusing on these tariffs also has the advantage that the reference group - the independent firms - are much more prominent because they represent on average 49 per cent of the considered local areas. However, the big four companies, and particularly E.ON and RWE, are much less represented as they offer the cheapest tariffs in less than 3 per cent of the region-time observations. Therefore, in some specifications, we are unable to identify the effect for some of the large incumbent. Table 6.9 shows the results.

These findings are consistent with the picture presented thus far. When it is identified, the effect on the big three (E.ON, RWE, EnBW) is positive and significant, implying that the tariffs of these large integrated firms have significantly increased compared to independent retailers. Only Vattenfall, seems to have adopted an even more aggressive pricing policy than the independent firms in this competitive segment and offered lower tariffs.[92] Again, we observe a significant negative effect for the municipal firms: they have become relatively cheaper than all other firms after the implementation of the Commission's decision.

[92] One main reason for this differential result might be that Vattenfall operate mostly in Hamburg and Berlin, which might are surely structurally different markets if compared to the rest of the country.

Table 6.9 Overall lowest tariff

	1,500 kWh		2,800 kWh		4,000 kWh		10,000 kWh	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
E.ON	-1.046**	(0.463)	27.19***	(0.571)	0.712	(1.698)	24.20***	(1.919)
RWE	16.39***	(0.516)	16.66***	(2.217)	-0.190	(0.492)		
EnBW	6.323***	(0.286)	32.70***	(0.384)	17.57***	(0.884)		
Vattenfall	-0.889***	(0.274)	6.042***	(0.188)	5.831***	(0.208)	18.78***	(1.308)
Stadtwerke	-0.402*	(0.212)	10.29***	(0.219)	15.84***	(0.269)	63.19***	(0.963)
Other	-1.616***	(0.125)	6.187***	(0.160)	5.425***	(0.204)	17.81***	(0.799)
E.ON × Post	2.322*	(1.189)						
RWE × Post	9.333***	(3.599)	3.384	(3.037)				
EnBW × Post	12.43**	(5.502)	-25.49***	(4.477)	6.407***	(0.916)		
Vattenfall × Post	-5.768***	(0.407)	-7.528***	(0.412)	2.487	(3.617)	-15.47***	(1.841)
Stadtwerke × Post	-13.04***	(0.430)	-9.145***	(0.527)	-3.702***	(1.233)	-68.01***	(1.393)
Other × Post	-4.474***	(0.200)	-1.406***	(0.283)	-5.489***	(0.482)	-27.11***	(1.028)
# of EIPs	-1.383	(2.247)	-1.997	(3.171)	-1.303	(3.804)	-13.78**	(6.481)
pop1: density	-0.003***	(0.001)	-0.015***	(0.001)	-0.020***	(0.001)	-0.007***	(0.002)
pop2: share foreign	-0.118	(0.164)	1.140***	(0.212)	1.166***	(0.270)	-2.201***	(0.630)
pop3: births-deaths	0.156***	(0.006)	0.351***	(0.009)	0.371***	(0.012)	0.00291	(0.028)
# Amadeus firms	0.0326	(0.030)	0.0469	(0.043)	0.101*	(0.055)	0.0463	(0.137)
Constant	330.6***	(1.004)	545.8***	(1.284)	746.4***	(1.604)	1756.5***	(3.903)
Observations	431,105		471,453		493,538		444,261	
Adjusted R-squared	0.830		0.736		0.788		0.871	

The dependent variable is the price a costumer using the different consumption plans (1,500 kWh, 2,800 kWh, 4,000 kWh, 10,000 kWh per year) would pay if she chose the overall cheapest tariff in her local network area. The control category for the firm-type dummies is the group of independent firms. We control for 8,208 zip-code fixed effects as well as 60 month fixed-effects. Standard errors are clustered at the zip-code level. t statistics in parentheses. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

The final piece of evidence relates to price dispersion (Table 6.10). **The difference between the highest (baseline) tariff and the lowest tariff in each regional market has significantly increased in all areas where the incumbent firm was one of the big three German operators if compared to areas where the incumbent were independent retailers**.

This is true for all consumption plans. More markedly than in the previous regressions, the coefficients' estimates for Vattenfall and the municipal firms are negative and significant. This means that the price dispersion has even decreased in areas where these firms were incumbents. The result for the municipal firms might be related to their potentially different objectives, which might make them less focused on profit maximisation. This could explain why they priced even more competitively than small independent firms. The fact that Vattenfall pricing behaviour is substantially different from the behaviour of the big three German firms could be because it mainly operates as in incumbent in unique markets - Berlin and Hamburg - where competition might be tougher due to lower brand loyalty and more informed consumers.[93]

[93] Vattenfall is not a traditional German brand that was present in the regions where it operates for several decades. It inherited a customer base from the previous incumbents in the 1990ies, but costumers never appeared to be particularly attached to the firm.

Table 6.10 Price dispersion (Incumbent's Baseline Tariff – Overall Cheapest Tariff)

	1,500 kWh		2,800 kWh		4,000 kWh		10,000 kWh	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
E.ON	-0.266	(4.266)	-7.918	(6.668)	-2.171	(9.571)	-71.61	(45.41)
RWE	0.948	(4.116)	-8.678	(5.553)	12.05	(8.655)	-59.96**	(27.65)
EnBW	3.712	(7.460)	8.717	(8.717)	41.33***	(11.20)	251.3***	(39.62)
Vattenfall	-27.83***	(4.054)	-23.03***	(5.433)			-133.8***	(27.49)
Stadtwerke	3.416	(3.648)	-3.593	(4.979)	0.502	(7.674)	-34.77	(26.92)
Other	6.382	(4.037)	3.976	(5.426)	13.15	(8.572)	-30.17	(27.47)
E.ON × Post	3.052**	(1.421)	4.591*	(2.390)	-0.749	(2.058)	51.79***	(8.421)
RWE × Post	9.533***	(1.436)	21.46***	(2.425)	23.59***	(2.100)	118.6***	(8.512)
EnBW × Post	5.108***	(1.419)	15.12***	(2.384)	13.83***	(2.059)	97.60***	(8.482)
Vattenfall × Post	-8.530***	(1.616)	-6.184**	(2.429)	-30.27***	(2.038)	98.05***	(8.559)
Stadtwerke × Post	-3.170**	(1.447)	0.0338	(2.431)	-9.491***	(2.130)	7.183	(8.690)
Other × Post	1.197	(1.428)	6.775***	(2.394)	-2.977	(2.125)	36.76***	(8.494)
# of EIPs	-3.622	(2.533)	-5.646	(4.300)	-6.550	(5.631)	-40.15	(33.40)
pop1: density	0.0123***	(0.00165)	0.0318***	(0.00247)	0.0400***	(0.00306)	0.0378***	(0.00854)
pop2: share foreign	-0.0138	(0.190)	-0.552*	(0.318)	0.00609	(0.430)	5.496***	(1.074)
pop3: births-deaths	-0.227***	(0.00901)	-0.474***	(0.0130)	-0.569***	(0.0171)	-0.204***	(0.0439)
# Amadeus firms	0.0619	(0.0571)	0.0483	(0.0940)	-0.0236	(0.140)	0.0636	(0.336)
Constant	16.97***	(3.985)	24.92***	(5.480)	23.10***	(7.956)	162.5***	(28.94)
Observations	480496		480496		482226		479906	
Adjusted R-squared	0.926		0.897		0.872		0.858	

The dependent variable is the price dispersion within a given zip code defined as the difference between the yearly prices a costumer using the different consumption plans (1,500 kWh, 2,800 kWh, 4,000 kWh, 10,000 kWh per year) would pay if she chooe the incumbent's baseline tariff or the cheapest tariff in her local network area. The control category for the firm-type dummies is the group of independent incumbents. We control for 8,208 zip-code fixed effects as well as 60 month fixed-effects. Standard errors are clustered at the zip-code level. *t* statistics in parentheses. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

The findings from these regressions essentially sum up the results obtained for the baseline tariff with those obtained for the cheapest tariff. This specification reinforces our identification strategy because it represents a difference-in-difference-in-difference strategy. We focus not only on the difference between large vs. small incumbents but add the cross-sectional variation among more vs. less competitive tariffs. Our results are strongly consistent with the expectations generated by our identification strategy. When the incumbent firms are the big, vertically integrated incumbents, the price spread within an area increased after the Commission' decision was implemented and, accordingly, wholesale prices went down. Our explanation for this is that **the incumbent firms pass on less of the wholesale price reduction to their customers than more competitive retailers focusing on the more mobile customer base. This effect is smaller, when the incumbent itself was a smaller, independent firm.**

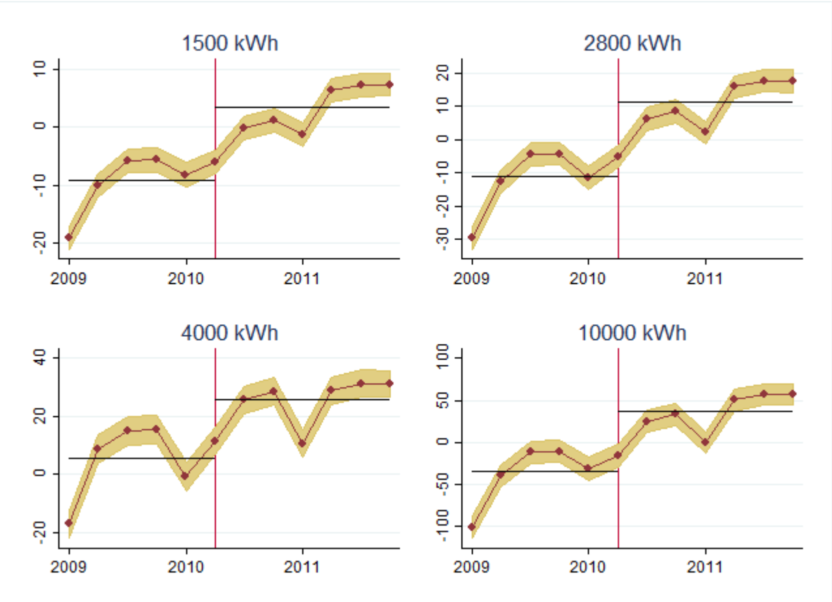
6.5.5 Heterogeneous treatment effects over time

The results so far focus on the heterogeneous response to the Commission's decision across firms' type. For each firm type, we estimated an average treatment effect over time that measures the long-term impact after 2010. However as mentioned above, we expect changes in wholesale conditions to only slowly affect retail tariffs because energy is purchased from wholesale markets via long-term contracts. This implies that we can clearly predict how the treatment effect should manifest over time. As the share of energy purchased at a lower price increases over time because some of the existing long-term contracts expire, we would expect the treatment effect to slowly materialise after the decision is implemented. Moreover, we would expect this trend to be even slower for the tariffs offered by large, vertically-integrated incumbents because they tend to purchase energy from wholesale markets via longer-term contracts. Therefore, looking at the heterogeneity of the treatment effects over time should help us to refine our identification strategy.

To facilitate the interpretation of our analysis and because we observed that the effects for the big three German firms (E.ON, RWE, and EnBW) are similar, we group these three firms into one category. We then disaggregate the implementation and the post periods into quarters. Finally, we estimate time-heterogeneous effects for each quarter, i.e. instead of estimating one coefficient for the 'post' period, we estimate 13 different coefficients over time.

Figure 6.22 focuses on the incumbent's baseline tariff, which covers much of the customers' base and is the less competitive part of the market. It reports the evolution over time of the point estimates for the heterogeneous effects together with the 95 per cent confidence interval. The reported coefficients represent the differential price-effect of the big three utilities if compared to the independent firms.[94] We also highlight the implementation period (up to March 2010) and the post-period. Finally, the black line represents the average effect over that period in time and the results discussed so far.

Figure 6.22 Heterogeneous Treatment Effect over Time – Incumbent's baseline tariff



Source: Our calculations based on Verivox Data

During the implementation period, the tariff of the big three was on average lower than those of the independent incumbents. However, during 2009, 2010, and 2011 there is a clear positive trend that leads tariffs of the big three incumbents to exceed those of the independent firms. This is what we would expect: the treatment effect is observed starting at the end of the remedies' implementation period and it gets stronger during 2010 and 2011.

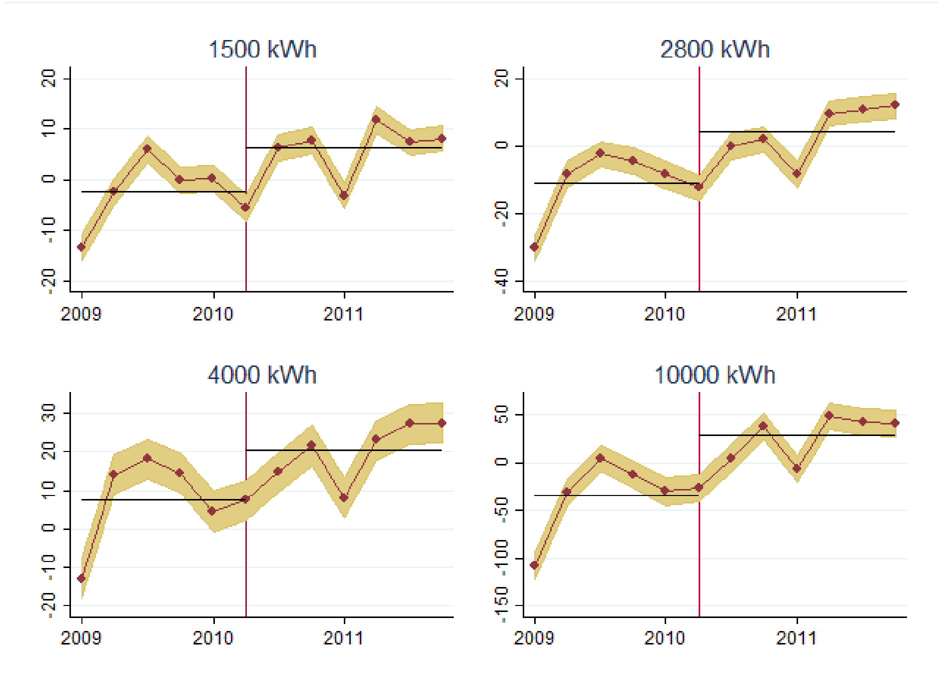
Figure 6.23 then focuses on the price dispersion within a regional market. The picture is similar as above. Comparing regions where the big three utilities were incumbents to regions with an independent incumbent, price dispersion is negative and close to zero during the

94 We do not report the coefficients' estimates for Vattenfall, the municipal utilities and the other firms for the sake of simplicity. The results are however in line with those presented above: a negative trend for the Stadtwerke and no significant effects for the '*others*' category.

implementation periods and it increases to become positive and significant during the two subsequent years.

Again, we cannot take these findings as clearly identifying a causal link between the E.ON alleged abuse in wholesale markets, the Commission's decision, and retail tariffs. However, these results are consistent with our identification strategy. E.ON, RWE, and EnBW are expected to increase their prices with respect to the independent firms and to do so increasingly over time.

Figure 6.23 Heterogeneous Treatment Effect over Time – Incumbent's baseline tariff



Source: Our calculations based on Verivox Data

6.5.6 Robustness checks

As for the wholesale analysis, autocorrelation is a major issue for inference in the presence of relatively high-frequency data with a long time-series component. Different to Section 6.4, however, for the retail analysis we can use a very rich panel with many cross-sections. This allows us to cluster the White robust standard error at the zip code level which, to some extent, provides a way to control for autocorrelation of a general form. We assume that all 60 observations within one cluster are correlated and this correlation coefficient than picks up the time-correlation.

To test the robustness of our results and be more confident of our inferences, we try to deal with the problem of potential autocorrelation by decreasing the frequency of the data. We therefore collapse our monthly data into a year average. For each zip code we therefore have five observations over time: one year before the treatment (2008), one implementation year (2009), and three years after the implementation of the treatment (2010, 2011 and 2012). Given the large cross-section, we are still left with a very large number of observations. Using annual averages, the problem of autocorrelation should in this case be much less severe.

We report the results for the baseline tariffs, the overall cheapest tariff, and the price dispersion in Annex 4 in Table A4.6, Table A4.7, and Table A4.8 respectively. In terms of sign, size and significance our main results are unaffected. The big three German incumbents: E.ON, RWE and, to a lesser extent, EnBW significantly increased their baseline and cheapest tariffs with respect to the independent incumbents. Price dispersion also increased in regions with one of the big three incumbents if compared to regions with independent incumbents.

6.6 Conclusions

In this chapter we studied the effect of a specific competition policy intervention: the EU Commission’s case against E.ON for its alleged abuse of dominant position in the German wholesale electricity market. The investigation confirmed the presence of competition concerns and, as a consequence, E.ON committed to divest a total of 5,000 MW of generation capacity.

Within our general framework, we analyse how the enforcement of the decision affected the short run competitive outcome: prices. The focus on a specific case study allows us to be more precise in modelling the peculiarities of the market and the case and provide more convincing evidence on the causal effect of the decision. Because the intervention directly affected upstream electricity markets, we first study the effect of the Commission's decision on wholesale price. However, to get a richer picture of the effect of the firms’ conduct and Commission’s decision on final customers, we also analyse the downstream effect of the decision on German retail tariffs. For both levels of the analysis we adopt a difference-in-difference methodology to identify the effect of the policy intervention. Our exact approaches and identification strategies are tailored to the specificities of the German electricity market.

At the wholesale level, we exploit that prices are mostly determined through a centralised energy exchange market: the EEX. Even though most electricity is traded via over-the-counter contracts, the EEX constitutes an opportunity cost for energy trading and, therefore, is a good benchmark for measuring wholesale prices. The EEX market is also very liquid and swiftly responds to changes in energy supplied and the intensity of competition, which makes it particularly well suited for an empirical analysis.

Our identification is based on the observation that energy suppliers have more market power during peak periods when demand is higher. Since the supply schedule is highly convex and much steeper during the peak period (8am–8pm), shifts to a lower or higher capacity schedule would have much larger effects during peak time. We therefore expect a convergence between peak and off-peak prices if market power is reduced.

We estimate a wholesale price equation using daily data on peak and off-peak prices from the EEX. We control for a very large set of relevant determinants of wholesale prices such as input prices, demand conditions, and supply conditions. We identify the short-run effect of the Commission by looking at convergence between peak and off-peak prices in the weeks around each divestiture, while the long-run effects are identified by looking at the convergence over a period of one or two years after the implementation of the remedies.

Our models perform very well in explaining wholesale prices’ variation. We find strong and statistically significant convergence effects in the short-run as well as in the long-run. The size of the effects is also economically very relevant, with convergence varying between three to 15 €/MWh. Placebo regressions based on Spanish and French data support our identification strategy. These findings are consistent the view that the Commission’s decision, by affecting competition in the EEX market, reduced wholesale prices.

The next question is whether this significant reduction in wholesale prices caused by the Commission’s decision had an impact on retail tariffs. Again, we tailor our empirical framework to other specificities of German electricity markets to carefully answer this question. In particular, we base our identification strategy on few empirical observations. First, there are three main types of energy retailers active in the German markets: large, vertically integrated incumbents, municipal firms, and small, independent retailers. They are structurally different in the degree of vertical integration with wholesalers and producers, their size, geographical scale, ownership structure, and objectives. These structural differences affect their energy purchasing strategies and, particularly, the type and length of long-term contracts they stipulate with the wholesalers. Second, the pass-on also depends on the extent of downstream market power. The large perceived retail costumers' switching costs, particularly for private households, create a stable customer base for incumbent retailers, which can be exploited with high tariffs. Third, most contracts between energy suppliers and retailers are long-term. Therefore if at all, one would expect changes in the upstream market to only gradually affect retail prices as existing supply contracts are successively replaced by new ones.

We collect a unique dataset from a German price comparison site,Verivox, with monthly price data from 2007–2014 for more than 8,000 different zip codes by more than 800 different electricity providers. We differentiate between three different types of household consumption (annual consumption: 1,500 kWh, 2,800 kWh, 4,000 kWh) and one typical commercial costumer (10,000 kWh). We exploit this enormous variation across firms' types, tariffs' types, regions, and time periods to implement our identification strategy. Specifically, we expect large, vertically integrated incumbents to less quickly pass-on upstream savings than small, non-vertically integrated incumbents, hence, to increase their tariffs. We also expect the difference between the highest, less competitive, baseline tariff and the lowest, most competitive price within a local market to significantly increase after the Commission's decision in markets where the incumbents are the big vertically integrated operators. Finally because of the price rigidity introduced by long-term contracts, we expect these reactions to only slowly adapt following changes in wholesale prices.

We find strong and significant evidence that all retail tariffs and the within-area price dispersions have increased in areas where the incumbent was one of the big three, vertically integrated, energy incumbents (E.ON, RWE, EnBW) if compared to small independent firms. We also find evidence that this effect slowly materialised over the two years following the implementation of the Commission's remedies. These results are in line with the view that the Commission's decision, by impacting wholesale tariffs, also impacted electricity retail prices.

As for the previous chapter, a word of caution is necessary to the conclusion. Even though we tried to exploit the specificities of electricity markets to very carefully design our empirical approach and set up our identification strategy, at both levels of the analysis we cannot completely exclude that other relevant events that affected the functioning of markets might also drive the observed results. In both analyses we tried to identify these alternative channels and we were partially able to provide evidence that they played a less crucial role than the E.ON decision.

However, particularly with regard to retail markets, this is very difficult to do. This is specifically because the retail market's analysis cannot be considered to be a true ex-post evaluation of the Commission's decision, which solely concerned wholesale markets. The downstream analysis has the broader purpose to provide quantitative evidence of the potential implications of an antitrust decision on adjacent markets and to shed light on other important competitive aspects of electricity markets. Specifically, our analysis aimed at drawing conclusions on the extent of the pass-through of the reduction of wholesale electricity prices (wherever they come) on the retail prices, which mostly result from the specific conditions of competition in the retail market.

On the whole, we believe that the empirical regularities identified in this chapter provide consistent and convincing evidence that the Commission's decision had a key influence on the functioning of the German electricity markets after 2009 and benefitted consumers.

7 Case study: Merger between Gaz de France and Suez

In this chapter, we focus on a merger case to more precisely assess the direct effects of a merger decision and its associated remedies on the market under consideration. The case study is based around Gaz de France's (GDF) acquisition of Suez in 2006, which aimed to create one of the world's largest energy companies. The merger impacted on both the electricity and gas markets at several stages in the supply chain in both Belgium and in France. In the case of the Belgium gas market, on which we focus here, there were horizontal and vertical competition concerns in supply and wholesale markets.[95]

The aim, specifically, is to quantitatively evaluate the price effects of the merger and the remedies approved by the European Commission on the market for trading on the Zeebrugge hub (ZEE hub).[96] The hub, as part of the Belgian gas wholesale market, suffered infrastructure access and liquidity issues before the merger. Part of the negotiated remedies aimed to free up access to the hub, which - if effective - should have generated higher traded volumes and lower prices in the hub. The study will also provide some post-merger insights of the supply market at a descriptive level.

We begin by presenting the specificities of the case followed by a broad description of the Belgian market and market changes that took place post-merger. We will then present the data and economic analysis of the impact on the market for trading on the ZEE hub.

7.1 Introduction to the case

On 19 June 2006, the Commission initiated proceedings under Article 6(1)(c) of the Merger Regulation due to competition concerns around a proposed merger between GDF and Suez. At the time of the merger, GDF was active in the gas sector at all levels in Belgium and in the electricity market, with joint control (along with Centrica) over SPE - the second biggest player in the Belgian electricity market. The Suez group's main energy subsidiaries were Electrabel (electricity and gas supply), Distrigas (gas wholesale and supply) and Fluxys (gas infrastructure, transit, storage and transport).[97]

The Commission's ensuing investigation found that, given the horizontal and vertical overlaps between the two companies' activities, the proposed transaction raised significant competition concerns at all levels of the Belgian gas market. At the gas wholesale market level, the Commission was concerned it would significantly impede competition as it would:

- Give the new entity (GDF Suez) control of most gas imports into Belgium through its ownership of Distrigas. This risked excluding competitors from downstream gas (and electricity) markets.
- Result in potential vertical problems due to the parties' control over essential infrastructure (such as the transmission and transit networks, as well as storage facilities). Due to the parties' control over Fluxys (the network operator), they would have privileged access to supply infrastructure and storage.
- Certainly not improve access to the ZEE hub, with Distrigas & Co. (a subsidiary of Distrigas) controlling rights of access to the hub. Parties wishing to access the hub had to obtain capacity rights through an entry/exit agreement with Distrigas & Co. This meant that Distrigas & Co could make non-transparent agreements with all hub customers negotiated on a bilateral basis. This central role of Distrigas & Co posed a real problem in terms of access, as Distrigas itself was also a competitor in the hub. For example,

95 Throughout this case study we refer to Belgian wholesale markets as the import of gas from abroad and trading between gas shippers (among others, on the hub). We refer to Belgian supply markets as the markets where gas is sold to large customers, power generators or retailers.

96 While it would have been interesting to provide a more detailed ex-post analysis on other aspects of the Belgian gas market as well, only detailed price data on the hub was made available to the case team. Due to confidentiality issues related to other data, it was not released for this study.

97 While earlier the company was named Distrigaz, it was later renamed Distrigas. We use throughout the document 'Distrigas'.

there were issues regarding privileged access to information obtained by its control of access to the hub.

In response to these concerns, GDF and Suez offered extensive remedies including:

1. Divestiture of the Suez group's holding in Distrigas to a third party[98];
2. Restructuring of the activities of Fluxys and relinquishing of all control over the company. Fluxys' activities were to be reorganised into two entities – Fluxys SA and Fluxys International. Fluxys SA was to own the entire Belgian gas transmission and transit system and all Belgian gas storage infrastructure. To this end, Suez would also transfer to it Distrigas & Co. The parties undertook not to hold more than 45 per cent of the capital of Fluxys SA (with Publigas holding another 45 per cent). Fluxys International was to own the Zeebrugge LNG terminal, Huberator (the hub operator) and the other non-regulated Belgian and international assets (BBL, Gas Management Services Limited, Belgian Pipe Control, C4Gas and Endex). The parties further agreed not to hold more than 60 per cent of the capital of Fluxys International as well as to give partial control of its investment activities to the management committee of Fluxys SA.
3. A series of additional measures relating to gas infrastructures in Belgium. The parties undertook to create a single point of entry at Zeebrugge which would bring together the hub, the LNG terminal, the point of arrival of the Interconnector Zeebrugge Terminal and the point of arrival of the Zeepipe terminal; and
4. Divestiture of GDF's holding (via Segebel) in SPE. GDF were to relinquish their 50 per cent shareholding in Segebel (a company that had a majority shareholding in SPE's capital).

Altogether, these remedies were intended to facilitate the entry of new competitors and foster competition between existing competitors. They were also intended generate increased access to the hub, which should then lead to higher liquidity and volumes traded, and to lower prices. As a result of these remedies, the Commission concluded that the merger would not significantly impede competition in the European Economic Area (EEA) or any substantial part of it.

7.2 The Belgian gas market

7.2.1 An overview of the market

Belgium imports all the natural gas it consumes, either via gas pipelines through 'interconnection points' or via Liquid Natural Gas (LNG) terminals. The Belgian gas network is an integrated network, used for *international transit* as well as *domestic transmission*.

Belgium's role for international transit is important*;* with the long-term reserved transit capacity in 2006 being 48 billion m^3/year, representing two-and-a-half times the volume of gas consumed in Belgium, or 10 to 11 per cent of consumption in Western Europe[99]. The ZEE hub is crucial for this transit role (as seen in Figure 7.1), with the pipelines that go through the ZEE hub being used almost exclusively for gas transit[100]. It was initially designed to route gas between Britain and the continent (both forward and reverse flows) and aimed to help network users achieve a balance between their injection and withdrawal using intra-day transactions through 'over-the-counter contracts' (OTCs). The role of the ZEE hub became more prominent leading up to 2006 with the gradual liberalisation in gas markets, which increased short-term negotiations and gas price arbitrage transactions.

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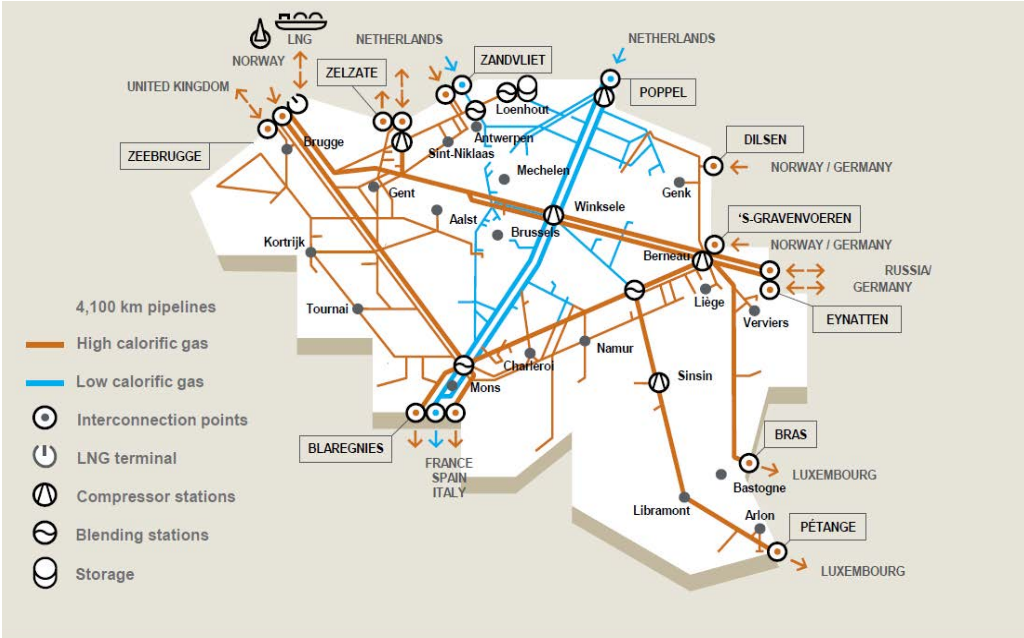
98 This remedy also involved arrangements for supply contracts and transference of storage capacity control in Belgium to any existing Electrabel Customer Solutions (ECS) public supply customer.

99 CREG. 2006. 'Study on the planned merger between Gaz de France and Suez'. Undertaken in application of Article 23, paragraph 2 of the law of 29 April 1999 on the organisation of the electricity market and Article 15/14, 2, paragraph 2 of the law of 12 April 1965 on the transmission of gaseous and other products by pipeline.

100 Heather, P. 2012. 'Continential European Gas Hubs: Are they fit for purpose?' *The Oxford Institute for Energy Studies.* Available at: http://www.oxfordenergy.org/wpcms/wp-content/uploads/2012/06/NG-63.pdf (see p11)

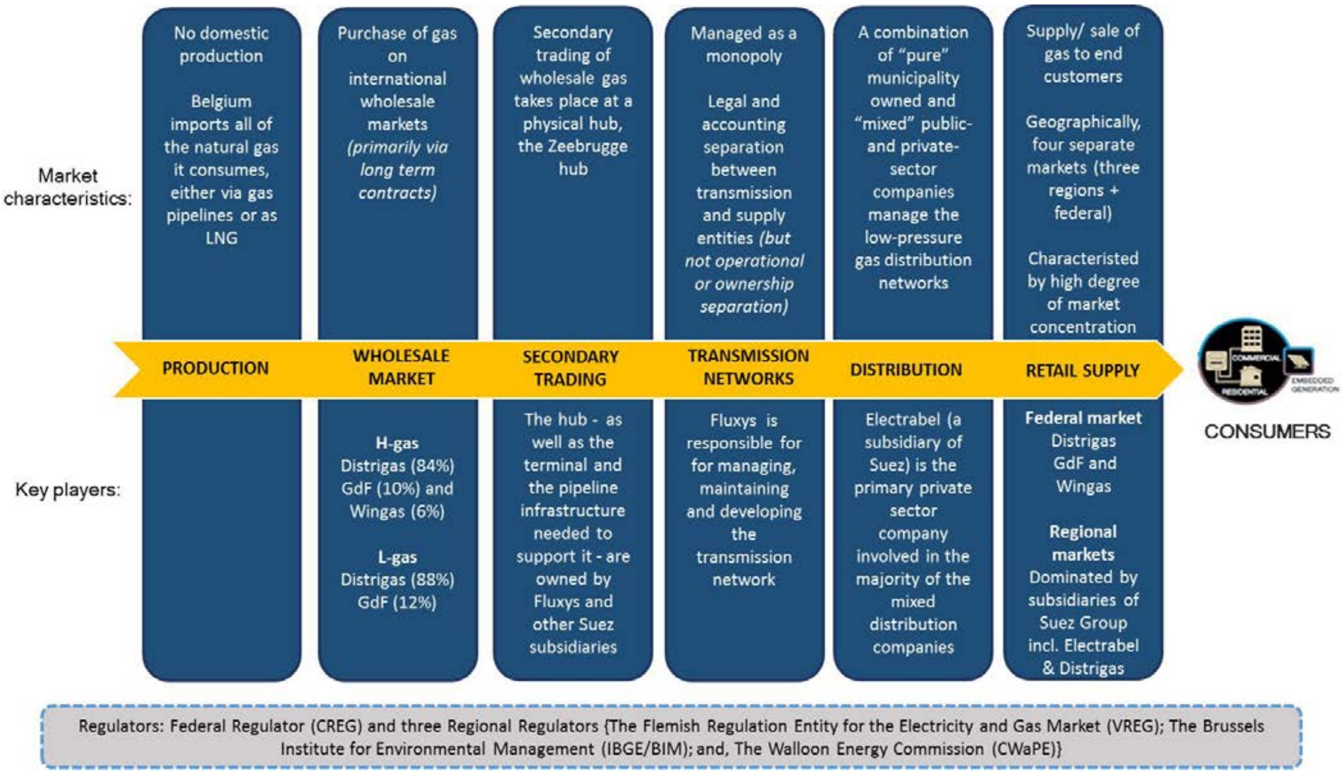
Figure 7.1 Schematic overview of the Belgian gas market in 2006



Source: CREG. 2006.[101]

At the time of the merger, the Suez group and its subsidiaries played a dominant role in the Belgian gas markets, operating across all segments of the supply chain as illustrated in Figure 7.2 Figure 7.2. Moreover, GDF was also a key player in the gas markets in Belgium as well as being active in the electricity market, with joint control (along with Centrica) over SPE – the second biggest player in the Belgian electricity market.

Figure 7.2 Stylised overview of the structure of the Belgian gas market before the merger



[101] H-gas is High Calorific Gas, it has a methane content of 87-99%, has high energy content and is sold at a higher price. L-Gas is Low Calorific Gas and has a methane content of 80-87%. It has a lower energy content and a lower price.

Based on information sourced from CREG Annual Reports (years 2005 and 2006) and Cambridge Economic Policy Associates (2008) Structure and functioning of the natural gas market in Belgium in a European context. Notes: (i) Belgium consumes two different types of natural gas, namely H-gas (with high caloric value) and L-gas (with low caloric value) (ii) Distrigas was previously known as Distrigaz (iii) the above diagram is a simplification and should not be seen as a comprehensive depiction of the Belgian gas market. For example, it does not include the storage segment of the supply chain

The Suez group had a significant stake across all levels of the markets in 2006: it had a stake of 57 per cent in Distrigas, 57 per cent in Fluxys and 98 per cent in Electrabel. Through these companies, it also controlled Distrigas & Co, Huberator and Fluxys LNG. While the gas directives led to a legal unbundling of Distrigas and Fluxys in transit and transmission networks, in terms of ownership, Suez controlled a large part of the Belgian gas infrastructure at the time. In particular,

Regarding **domestic transmission**:

- This was solely owned by Fluxys as a monopoly. Fluxys was responsible for the management, maintenance and sale of capacity around the transmission network.

These domestic transmission activities were regulated with regards to third-party access and tariffs, subject to Belgian law and to a ‘code of conduct’.

The **gas transit market** had a differing ownership structure by pipeline:

- The H-gas pipelines through the ZEE hub belonged to GIE Finpipe, of which Distrigas owned 63.3 per cent. All capacity rights had been transferred to Distrigas & Co, while Fluxys was responsible for operational management.[102]
- The SEGEO H-gas pipeline between The Netherlands and France belonged to Segeo SA, of which Fluxys and GDF owned 75 per cent and 25 per cent respectively. Capacity was made available to Etac BV, of which Distrigas and GDF held 75 per cent and 25 per cent, respectively. Segeo was responsible for selling capacity and Fluxys for operational management.
- The pipelines used for L gas belonged to Fluxys, which controlled management and sale of capacity.

Table 7.1 provides a snapshot of the estimated equity participation of the Suez Group along various segments of the gas supply chain.

Table 7.1 Estimated equity participation of Suez group in various supply chain activities before the merger remedies

Supply Chain activity	Suez group companies	Total Suez group ownership (%)
Wholesale		
H-Gas	Distrigas	84
L-Gas	Distrigas	88
Trading (spot market operator)	Huberator SA	42
Supply	Distrigas	81
Transport	Distrigas and Fluxys	57.25-75.00
Distribution		
Flanders	Electrabel	30
Wallonia	Electrabel	49
Brussels capital	Electrabel	30
Storage	Fluxys	100
LNG	Fluxys, Tractebel	99
Hub services	Huberator SA	90

102 Capacity rights allow the owner of these rights to move gas through the pipelines.

Zeebrugge Hub

Part of Zeebrugge Hub	Operator	Owner	Ownership (%)
Terminal	Fluxys LNG	Fluxys	93
		Tractebel	7
Hub services	Huberator SA	Fluxys	90
Spot market	APX Gas Zeebrugge BV	Huberator SA	42

Source: Cambridge Economic Policy Associates (2008) Structure and functioning of the natural gas market in Belgium

In 2006, no Code of Conduct or other third-party access document existed in relation to transit activities, due to a suspension ordered by Belgium's Council of State in 2004[103]. Instead, Regulation (EC) No 1775/2005 applied to transit activities although this did not address the shortcomings in the application of third-party access rules to transit created by the Council of State ruling.

Fluxys owned 90 per cent, through its subsidiary Huberator, of the **ZEE hub** (which is part of the wholesale market). The remaining 10 per cent were held by Distrigas & Co.

Regarding the **distribution network**:

- Electrabel held majority stockholdings in local authority mixed public- and private-sector companies which, as managers of the distribution networks, were responsible for distribution. But following the transposition of the Gas Directive, most municipalities had agreed with Electrabel that retail activities were to be taken over by Electrabel Customer Solutions (ECS) and that the management of the distribution network was to be taken over and managed by the local authority utilities.

7.2.2 Potential competition issues

There were a number of structural issues prevalent in the Belgian gas market in 2006, and there was concern that the proposed merger would exacerbate such issues.

The Belgian gas market was characterised by **high levels of market concentration**. The proposed merger would increase the concentration at all levels, making the merged entity dominant across the entire market (as seen in Table 7.2).

Table 7.2 Market shares of the Suez group and the Gaz de France group in the Belgian natural gas market in 2006, %

	Wholesale market		Supply market	Transmission / Transit networks	Distribution network
	H-gas	L-gas			
Suez	84.37 (Distrigas)	88.21 (Distrigas)	86.3 (Distrigas + ECS)	100 (Fluxys + Fluxys LNG + Distrigas & Co.)	76 (mixed distribution network operators)
Gaz de France	9.82 (GDF)	11.79 (GDF)	7.2 (GDF + Luminus + ALG Negoce)	0	0
Total (after merger)	94.19	100	93.5	100	76

Source: CREG. 2006.

This dominance, particularly in the upstream parts of the market, meant any new entrants would be **dependent on a vertically integrated incumbent.** Distrigas (the incumbent) would continue to control upstream gas imports and could obtain details of the positions of all other parties through its control of the hub. This meant that Distrigas, through its vertically

[103] Judgment No 126.817 of 5 January 2004 (Distrigaz and Distrigaz & Co. v Belgian State).

integrated advantage, could unilaterally influence prices, potentially impacting the willingness of other parties to develop commercial activities downstream.

There also existed **issues around access to the transmission network despite unbundling provisions**. New entrants claimed they lacked effective access, with Fluxys (the operator) suspected of putting first the interests of the integrated company Suez rather than the rest of the network.

There were potentially distorting incentives to invest in the network, with incentives for a dominant company to defer investments (or keep them at lower levels) to drive prices up. As claimed by the regulator[104], delays in investments at Fluxys had already resulted in congestion on the natural gas transmission network in Belgium. This in turn had reduced the competitive pressure on Distrigas and led to a poor functioning of the hub in Zeebrugge.

Finally, in 2006 the ZEE hub provided **insufficient liquidity** to facilitate access to new entrants in the supply market. These problems with liquidity were attributed to the market power of Distrigas, poor accessibility to the hub and to capacity rights, as well as to the non-transparency of market information[105].

A focus on the potential competition issues regarding trading on the ZEE hub

A gas-trading hub is a liquidity instrument that provides services to facilitate exchanges between gas buyers and sellers in wholesale markets, enabling them to find sufficient volumes of supplies or to sell excess capacity in the short-term[106]. Trading on the ZEE hub was created to respond to the markets' need for a physical transfer point. It is typical (and important) for the development of an open market as it enables the development of an efficient gas market. If operating efficiently, a hub can promote competition in the market, allow price transparency, result in savings of transaction costs, secure supply and provide wider choice for buyers. It can also increase market liquidity, transparency and promote non-discriminatory access to the market.

Access to the hub was required via the transit network – which Distrigas & Co controlled[107]. Actual or potential competitors of Distrigas in the gas supply market could potentially buy gas at the ZEE hub, but third party access was a problem due to Distrigas & Co's monopolistic role as network operator[108]. Any trade also meant Distrigas could obtain details of the positions of competitors – this undermined confidence and discouraged market entry.

The remedies proposed aimed to reduce the barriers to entry by facilitating access to the hub and increasing the hub's liquidity.

The remedies, as outlined in Section 6.0, sought to overcome these issues with a range of divestitures and restructurings. The remainder of this report looks to assess the impact of the

104 CREG. 2006. 'Study on the planned merger between Gaz de France and Suez'.

105 Market liquidity (or liquidity) is a measure of the performance of a commercial market. To create a perfectly liquid market, the following conditions have to be fulfilled: (a) a large number and wide variety of buyers and sellers, with no company exercising significant influence; (b) entry and exit, with no technical, legal or institutional thresholds preventing entry; and, (c) transparent and open information on products, prices and quantities exchanged in the market. (CREG, 2006).

106 A hub can be a physical installation, where gas flows are connected to and pass through this point (as is the ZEE hub) or they can be 'virtual' whereby no precise geographical locational point is specified, although the gas needs still to physically enter and exit a particular geographical zone (for example, TTF where the Netherlands is the relevant zone).

107 The transit route to the hub was marketed by Distrigas & Co. Therefore to access the hub and transport gas to the Belgian transmission network it was necessary to have a transit reservation. Parties wishing to access the hub only, and who did not want to go any further than the Zeebrugge region, still had to obtain capacity rights by means of an entry/exit agreement with Distrigas & Co. All negotiations took place on a bilateral basis, with no real transparency.

merger and remedies using both a high-level descriptive analysis and a quantitative empirical analysis of the ZEE hub.

7.3 Descriptive analysis: the Belgian gas market post-merger

To assess the impact of the merger and the remedies, the timing of key milestones are crucial. This is also particularly important for the empirical analysis undertaken on the ZEE hub. Table 7.3 provides a timeline of the key milestones following the GDF Suez merger.

Table 7.3 Timeline of key events

Timeline	Event
May 2006	The merger between GDF and Suez is proposed
Nov 2006	The Commission approves the merger with remedies
May 2008	Suez's sale of Distrigas to ENI. *This was the first part of the unbundling process. Due to this action, the vertical chain to its subsidiary Electrabel in retail markets was broken*
Jun 2008	The sale of of Distrigas & Co. to Fluxys *This action potentially opened the pipelines towards the hub for competitors, as GDF Suez could no longer control the physical gas flows into / out of the hub. On its own, this remedy would have been insufficient to open up competition in the hub as Fluxys International (controlling the hub via the Huberator) was still 60 per cent owned by GDF Suez. However, part of the ruling by the Commission was that the decisions in both Fluxys SA and Fluxys International would be taken by the same board (see next point below). Given that GDF Suez could only control 45 per cent of Fluxys SA, this meant that it could not dominate decisions in Fluxys International. This effectively meant Suez lost control over the functioning of all of Fluxys' operations*
Jul 2008	The partial sale of Fluxys by Suez which reduced the shareholding of the merged entity (GDF Suez) as follows: ▪ Fluxys SA (transmission and storage): 45 per cent ▪ Fluxys International (LNG Terminal, BBL, Huberator, GMSL): 60 per cent Moreover, it was agreed that decisions in Fluxys SA and Fluxys International would be taken by the same board.
Jul 2008	The newly created GDF Suez officially comes into existence
May 2009	Publigas (an organisation owned by local municipalities in Belgium) increases its share in Fluxys SA to 51.47 per cent and becomes the *de facto* owner of Fluxys
March 2010	A decision is taken by GDF Suez to sell its remaining stake in Fluxys to Publigas

Overall, the merger remedies implemented in 2008 led to an ownership 'unbundling' of the merged entity GDF Suez in the hub, the supply markets and the retail market. In particular, the transfer of Fluxys and the remaining assets underlying the physical structure of the Belgian gas market (such as transit, transmission, hub, LNG and storage) were essential for simplifying access to the Belgian gas markets.

The merger remedies were to a large extent supported by the national regulator CREG, who was also involved in their implementation. Interviews with CREG suggest that the merger remedies empowered the regulator to further push and bargain for more regulatory changes to improve the functioning of the Belgian gas market. These included:

- Introduction of pro-active congestion management systems;
- Reduction in the number of balancing zones from four to one;

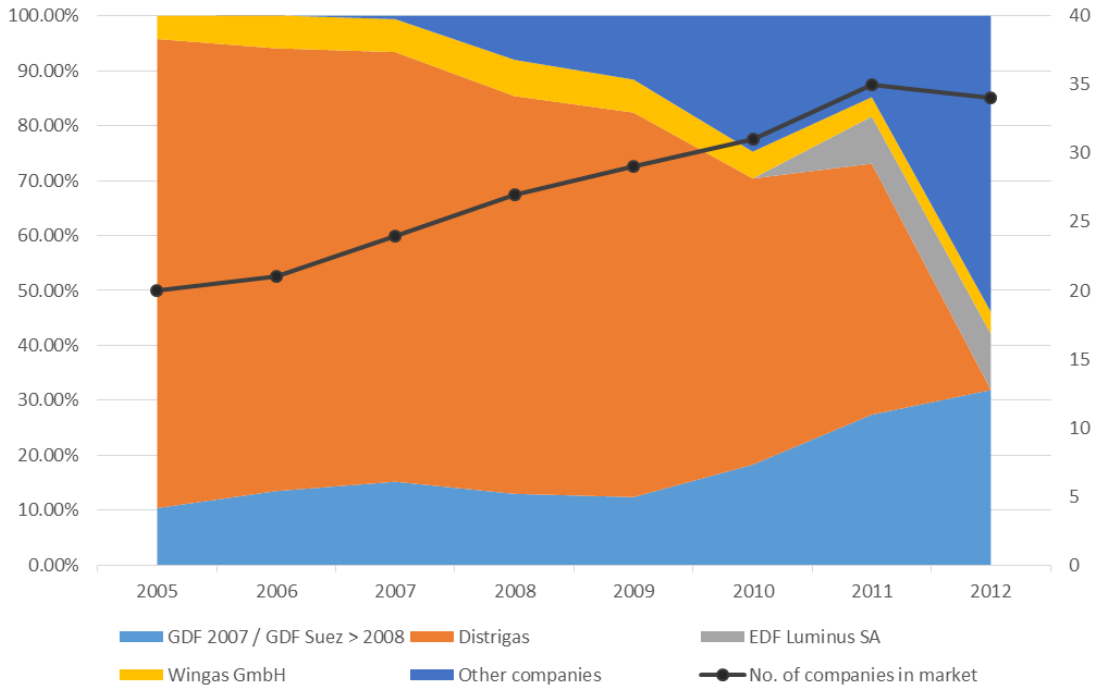
Implementation of a new Code of Conduct in June 2010 (CREG, 2010).Market outcomes post-merger

This section will provide an overview of some market outcomes for the time period after the merger, remedies and ensuing events. This analysis is merely descriptive.

7.3.2 Belgian supply markets

In the time period after the merger, remedies and ensuing events, the market shares at the supply market level changed significantly (as seen in Figure 7.3). The decline in Distrigas' market share (seen in dark orange) is notable post-2008 (driven significantly by its sale to ENI), with GDF Suez's (seen in light blue at the bottom) increasing its market share from 13 per cent in 2008 to over 30 per cent in 2012. The plotted line shows the number of companies active in the market, which increased from 20 in 2005 to 34 in 2012.

Figure 7.3 Evolution of market shares in Belgian supply markets



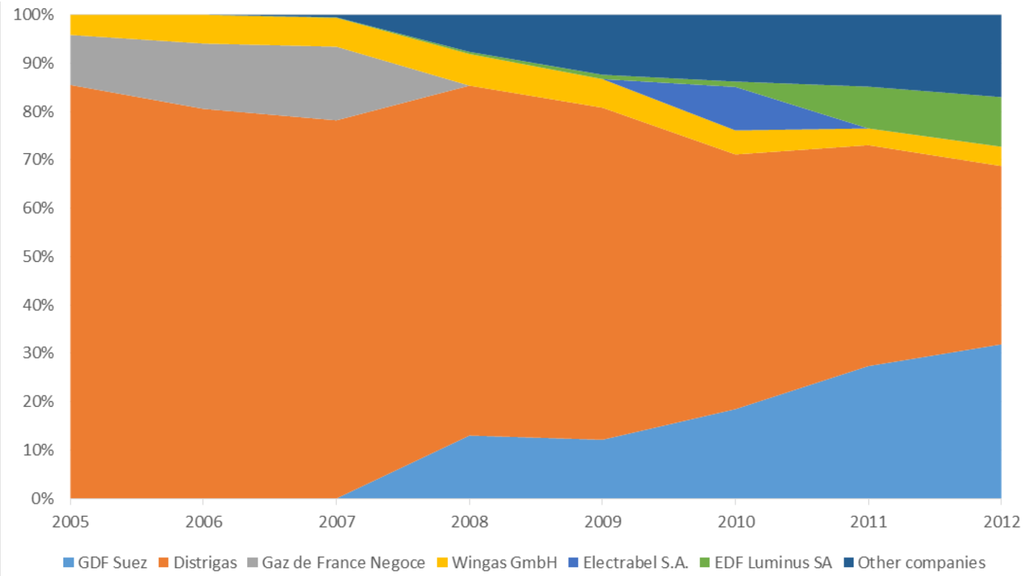
Source: CREG Annual Reports 2005-2011.

Alongside this, the number of active suppliers (or shippers) also sharply increased post-2008 – both for L and H markets (from four to 20 in the L market and from two to 27 in the H market)[109].

Sales volume follows a similar pattern to that seen in the market shares. As can be seen in Figure 7.4, Distrigas' share of the sales volume significantly declined post-2008, with other companies in the market delivering a much larger share of the total sales volume from this point onwards. Table 7.4 details the sales volume per company at a more granular level.

[109] Source: Data provided by the CREG (2013).

Figure 7.4 Sales volume (TWh) as a proportion of total volume in Belgian market (TWh), %



Source: CREG Annual Reports 2005-2011.

Table 7.4 Sales volume (TWh)

Company	2005	2006	2007	2008	2009	2010	2011	2012
No. of companies in market	20	21	24	27	29	31	35	34
GDF Suez				24.8	24	39.3	50.2	59.1
Distrigas	162.2	153.3	148	138.1	135.8	112.1	83.8	
ENI								68.4
Gaz de France Negoce	19.6	25.7	28.8					
Wingas GmbH	7.9	11.3	11.3	12.5	11.7	10.6	6.34	7.42
Electrabel S.A.	0	0	0	0	0	19.14	0	0
EDF Luminus SA	0	0	0.178	0.84	1.76	2.35	15.84	19.0

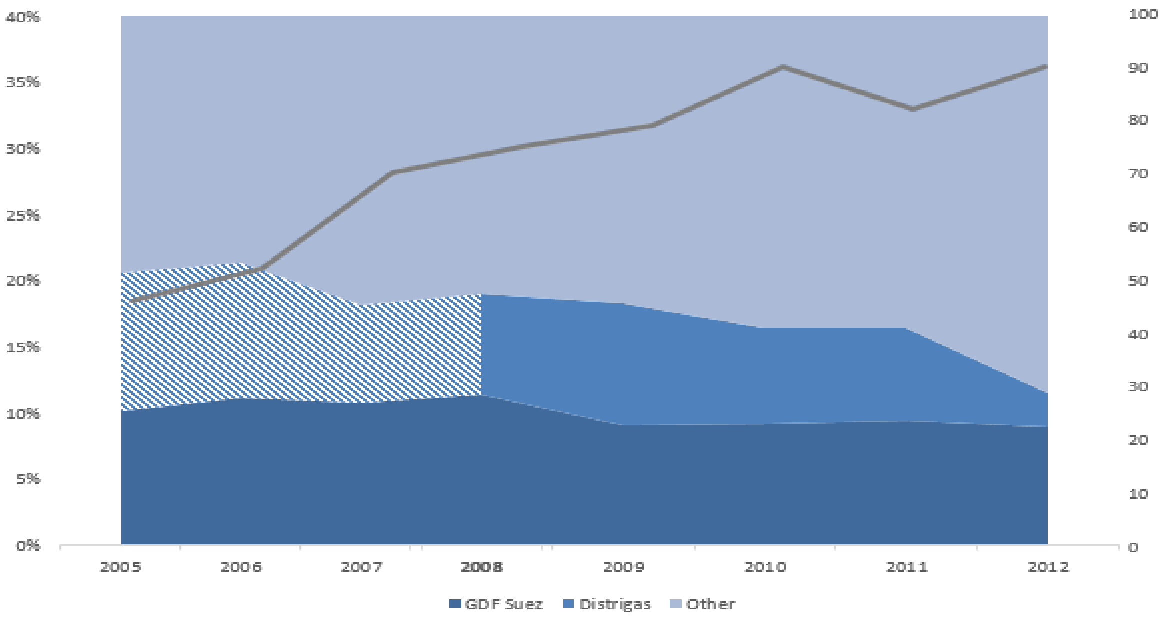
Source: CREG Annual Reports 2005-2011.

7.3.3 The ZEE hub

The ZEE hub also appears to be more accessible as a result of the associated remedies, resulting in an increase in the number of participants as well as in traded volumes (as seen in Figure 7.5 below):

- the market share of Distrigas fell considerably post-2008, as did the market share of GDF Suez; and
- the number of other market players as a proportion of market share, and in absolute figures, steadily increased after 2006.

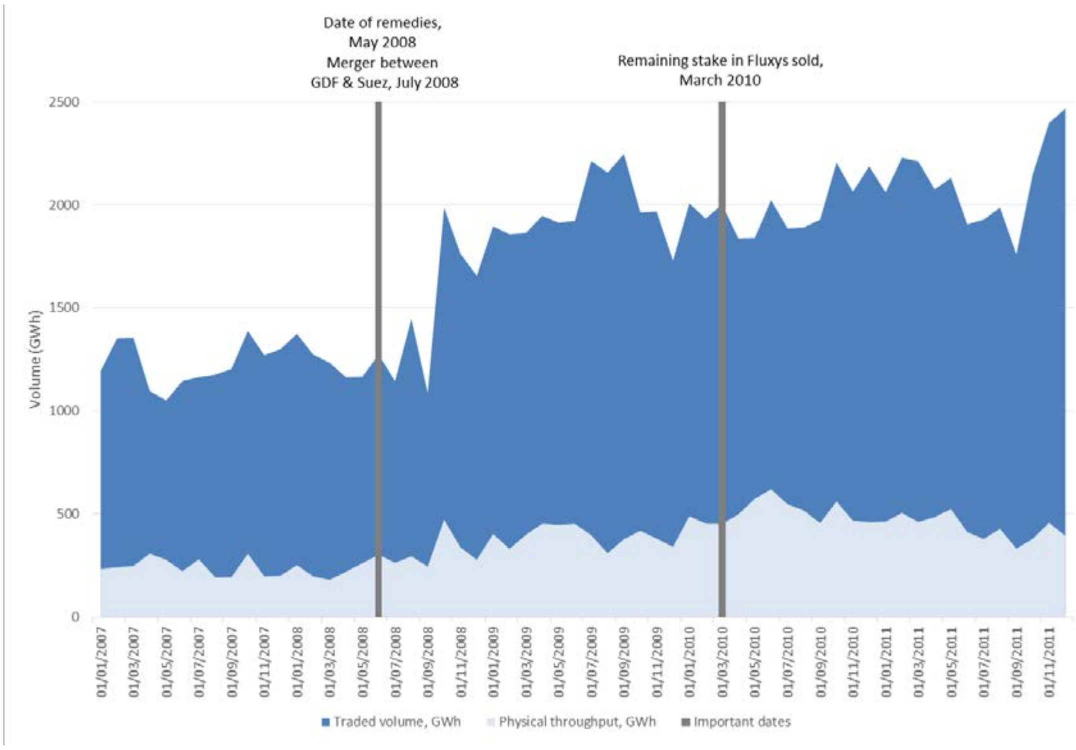
Figure 7.5 Evolution of the ZEE hub: number of customers, HHI and the daily traded volumes



Source: Data provided by Fluxys. 2015.

In terms of hub liquidity, Figure 7.6 indicates that after 2008 the average daily net traded volume slightly increased with respect to the daily average physical throughput. This indicates that volumes and liquidity at the hub increased.

Figure 7.6 Evolution of daily net traded volume with respect to the daily average physical throughput



Source: Huberator. 2013.

7.4 Econometric analysis of the ZEE hub

7.4.1 Overall approach

The empirical analysis aims to quantify the effects of the merger and associated remedy on the ZEE hub. As explained in previous sections, removing barriers to entry and facilitating access to the hub were part of the objectives of the main remedies imposed to the merging parties. We therefore believe that it is meaningful to assess the effect of the merger and associated remedies on the ZEE hub. Our analysis focuses on the effect on prices at the hub. The main variable of interest is therefore the wholesale day ahead prices at the ZEE hub[110]. It would also be interesting to assess the effect of the merger on traded volumes, but unfortunately the available data are not suitable for the proposed empirical analysis[111].

The key events being assessed are detailed in Table 7.5 below. They correspond to the key milestones described above.[112] We discuss our strategy to identify the effect of each event in the following subsections.

Table 7.5 Key events being assessed

	Event	Date of event	Time period over which effects are analysed
1	The Commission's decision	November 2006	January 2005 (beginning of our sample period) and June 2008 (date of event 2)
2	The effective divestitures of Distrigas and Fluxys and the consummation of the merger	June 2008	November 2006 (date of event 1) and March 2010 (date of event 3)
3	Last part of the remedies implemented (GDF Suez sells its remaining stake in Fluxys to Publigas)+ regulatory changes	March 2010	July 2008 (date of event 2) until the end of 2011

A Difference-in-Difference (DiD) analysis is used to compare prices at the ZEE hub with prices of a different hub taken as a control. The main empirical model is similar to the model used to estimate the effect of the E.On decision in the German wholesale market. In particular, the following price equation is estimated:

$$p_{it} = \beta treat_i + \gamma post_j + \delta treat_i \times post_j + +\omega_1\, power_{it} + \omega_2\, oil_t + \omega_3\, coal_t + \rho_1\, temp_{it} + \sum_{d=1}^{4} \varphi_d D_{d,t} + \sum_{m=1}^{11} \mu_m M_{m,t} + \sum_{y=2005}^{2010} \vartheta_y Y_{y,t} + \epsilon_{it}$$

The dependent variable p_{it} is the daily price in hub *i* at time *t*. The regressors are demand-side variables such as season and business cycles (day *D*, month *M*, and year *Y*), as well as temperature (*temp*)[113]. Supply-side controls are prices indices of power prices as well as oil products, to which gas prices are typically related (*power, oil, coal*)[114].

The identification strategy relies on the comparison between the ZEE hub and the control hub. The dummy *treat* is therefore equal to 1 for the treated prices, i.e. prices at the ZEE hub. We discuss our choice of the control hub in section 6.3.1.

The dummy $post_j$ is equal to one in the period after the events related to the merger took place. We discuss the strategy to identify the effects of the different events in section 6.3.2 below.

110 See below for a description of the database.

111 Data on traded volumes are available only since 2007 and only on a monthly basis for the control hub.

112 Since several events took place between May and July 2008, we cannot identify their effect separately. We take therefore June 2008 as the reference date for these events.

113 We also account for non-linearity in the effect of temperature by including a quadratic term in the regression.

114 Coal prices may influence gas prices as coal and gas plants both are important electricity generators.

7.4.2 Identification of the control group

The robustness of the identification strategy depends on the selection of a suitable control group because it represents what would have happened in the absence of the merger and remedies. In principle, the control group should be unaffected by the event and as similar as possible, in terms of characteristics, to the treated group. The choice of the control group proves to be a challenging task in this context for several reasons. First, there are no other hubs in Belgium, therefore we have to use a hub in another country as a counterfactual. Comparing different countries is generally problematic in the context of a DiD approach, as they might be characterized by different institutional features and subject to different shocks. However, it must be stressed that here we are not comparing countries as such, but just hubs, which are marketplaces sharing many features even if located in different countries. The structure and functioning of hubs is similar, and several market players are active in more than one hub in continental Europe.

There is also another issue that makes the choice of a control difficult in this case, namely the fact that all European hubs are, to some extent, interconnected. This implies that the possibility that a major event affecting one hub does not impact on another hub cannot be ruled out.

Taking into account these limitations, we identified the TTF hub in the Netherlands as the most suitable control hub. The reasons that led us to this choice are threefold:

- the fact that at the time of the merger the ZEE hub and TTF hub were the two largest hubs (in terms of liquidity) in continental Europe[115];
- the degree of interconnection between the ZEE hub and the TTF hub was low at the time of the decision (the European Commission, in her analysis, concluded they belonged to different markets);[116]
- data availability – there are few hubs for which prices are available back to the mid-2000's and this is an advantage in regards to the TTF hub. In terms of data availability, the only alternative control hub would be the British hub, which however is not suitable due to the reason outlined in the bullet point above, i.e. the high degree of interconnection with the Belgian hub.

One difference between the Belgian hub and the Dutch hub is that the ZEE hub is a physical hub (i.e. where the gas physically passes through the hub) while the TTF hub is a virtual hub (i.e. where gas enters only virtually after entering into a national system). However, this aspect does not pose too serious problems in terms of comparing both hubs, as even in virtual hubs the gas physically passes through, albeit at a national level.

Figure 7.7 compares prices at the ZEE hub (seen in blue) to those in the Netherlands (seen in orange). This comparison is only intended to observe trends at a high level. The two prices follow a similar pattern, consistent with the 'common trend assumption' on which the DiD strategy hinges[117]. Some short-term price spikes at the end of 2005 and beginning of 2006 reflect external events, including a cold snap in the UK and a shortage in the UK's main gas storage facility due to a fire outbreak. This had an immediate impact on the spot prices given the interconnectedness between the Belgian and UK markets[118].

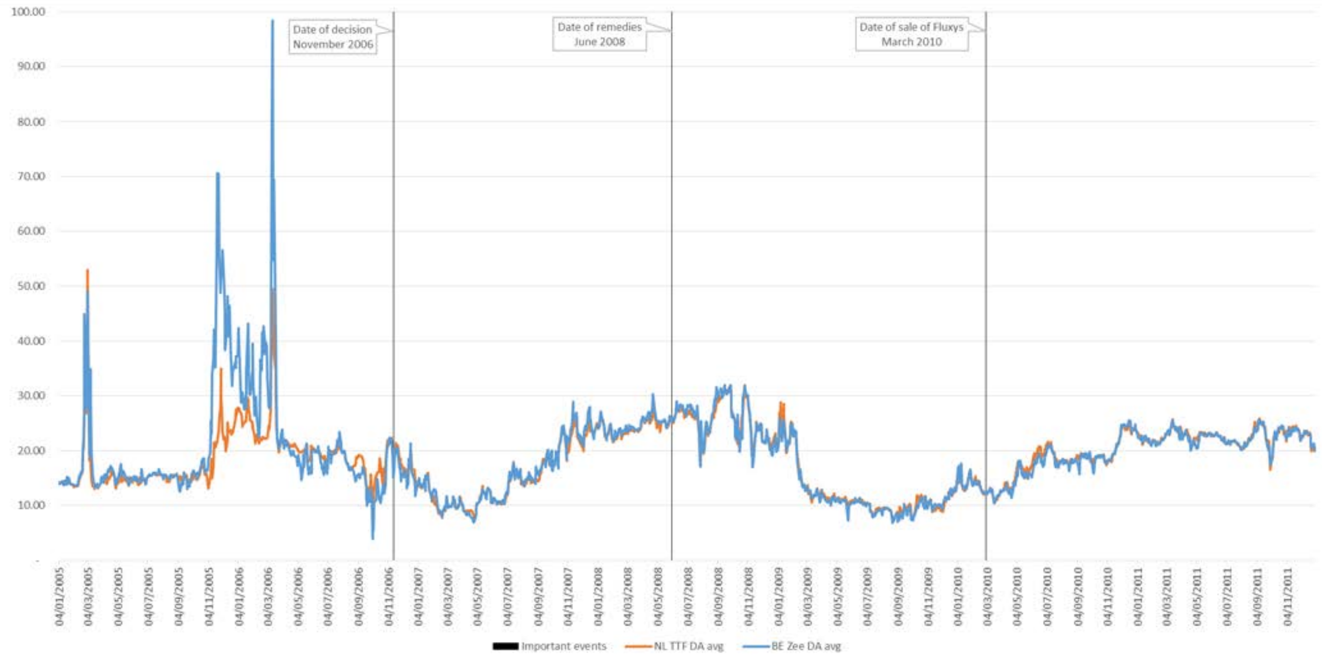
[115] See CREG. 2006. 'Study on the measures needed to improve the functioning and the liquidity of the Zeebrugge hub'. (F)060719-CREG-554.

[116] Although the Dutch and UK grids became more connected through the BBL pipeline starting in December 2006. This may have indirectly increased the connection between the TTF and Zee hubs through the UK grid.

[117] This assumption states that the treatment and control group would follow the same trend in the absence of the treatment.

[118] BBC News. 2006. 'Gas shortage sends prices soaring'. Available at: http://news.bbc.co.uk/1/hi/business/4802786.stm

Figure 7.7 Evolution of prices at the ZEE hub and at the TTF hub, 2005 - 2011



Source: Platts database. 2013.

7.4.3 Identification of the treatment period

To quantify the impact of different events related to the merger decision, different definitions of the 'post' period are tested. Three dates most relevant to assess the overall effect of the merger are identified, namely:

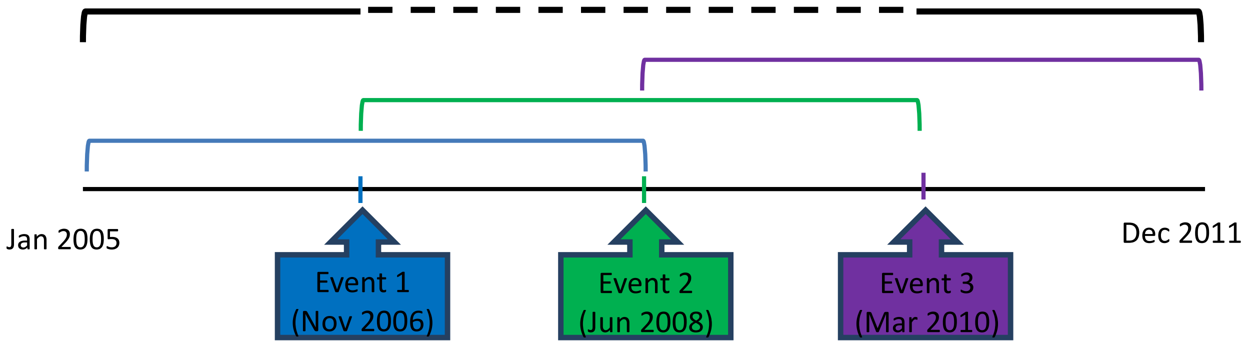
1. The time period after the official publication of the Commission's decision (in November 2006). When mergers are subject to authorisation, it is common in the retrospective evaluation literature to consider the date of the decision as the main relevant date to assess the effect of the merger (see for instance Choné and Linnemer (2012), Björnerstedt and Verboven (2012) and Aguzzoni et al. (2015)). In the case under consideration, between the Commission's decision and the actual consummation of the merger and its remedies, there was a time lapse of more than one-and-a-half years. However, the decision most certainly has triggered the merger and remedy process and the parties started negotiations on the terms of the merger and sale of assets. More generally, it seems likely that after the decision market operators began to adjust their strategies anticipating the finalisation of the merger and its remedies. Therefore, it is valuable to assess the impact of the decision itself. There are at least three merger retrospective studies finding evidence of price changes before the merger was actually completed (see Kim and Singal (1993); Prager and Hannan (1998); and Borenstein (1990)).

2. The time period after the merger was effectively finalised and different structural remedies were implemented. These events took place around June 2008.

3. The time period after GDF Suez sold its remaining stake in Fluxys to Publigas (March 2010). This is the conclusion of the unbundling process entailed by the remedies. In the same period several regulatory changes were implemented (see section 6.2.1 for a description of regulatory changes).

Our identification strategy aims at quantifying both the individual effect of each of these events, and their overall effect in the long-run. These effects are summarised in Figure 7.8 below.

Figure 7.8 Individual and overall effects of the events related to the merger



Source: own figure

We now describe our identification strategy for the different treatment periods.

Individual Effects of the Merger Events

To measure the effect of each of the three events, we consider three different definitions of the *post*$_j$ dummies, one for each event *j,* of the form:

$$Post_1 = \begin{cases} 1, & for\ \ t \in (T_1, T_2) \\ 0, & else \end{cases}$$

$$Post_2 = \begin{cases} 1, & for\ \ t \in (T_2, T_3) \\ 0, & else \end{cases}$$

$$Post_3 = \begin{cases} 1, & for\ \ t \in (T_3, T\ \ ) \\ 0, & else \end{cases}$$

where T_1, T_2, T_3 are the dates of the three events, and T is the last date in our sample period.

To disentangle the effect of each event, we run three separate regressions on three different sample periods, each of which represents the relevant before/after period around each treatment. In particular:

i) Treatment 1 (Event 1): period (0, T_2)

ii) Treatment 2 (Event 2): period (T_1, T_3)

iii) Treatment 3 (Event 3): period (T_2, T)

The treatment effects are therefore identified on a reduced sample period. In particular, for events 1 and 2, we only measure the effect that is realized before the next event takes place. Since the three events are far enough in time (more than one and a half year between each event), the number of observations on which we identify each treatment effect is quite large[119]. Therefore these should not be regarded as merely short-run effects. They represent the individual effect of each merger-related event in the period in which the event is assumed to display its effects.

[119] There is of course a trade-off in analysing the effect of additional events, as one would need to further split the sample period. Therefore we decided not to analyse separately the effect of the additional event that took place in 2009, namely the acquisition of control over Fluxys SA by Publigas.

Overall Effect of the Decision

To measure the cumulative effect of the merger and of its associated remedies, we identify the treatment effect in a long-run perspective. In particular, we assume that the overall effect of the decision can only be observed when the last remedy has been implemented, and compare what happened after all remedies were implemented to the period prior the Commission's decision. We thus estimate the effect of the previously defined $post_3$ dummy and exclude the implementation period (December 2006 - February 2010) from the analysis.

The overall effect is therefore identified on a reduced sample period, but given that we have data from January 2005 until December 2011, we have a large enough number of observations for both the before and the after periods.

7.4.4 The Data

The dependent variables are daily transaction price data for day-ahead wholesale natural gas traded during working days as published by Platts, both for the Belgian hub and for the Dutch hub. Our sample period goes from January 2005 until December 2011. For each working day (i.e., Monday to Friday), these data reflect the price range of a standardised quantity of natural gas to be delivered at a constant flow rate throughout the next working day after assessment (e.g., Friday's assessment reflects Monday's delivery).

Detailed information on the methodology used to construct these market-on-close price assessments, plus other background information, is available in the Platts database. All prices are denominated in €/MWh. Given the limited liquidity of within-day markets, the usual convention is followed and refer to these day-ahead prices as 'spot' since they provide traders with a final opportunity to trade gas out of a forward position before physical delivery.

Platts launched coverage of the continental gas markets in August 1999, with assessments for the Belgian hub of Zeebrugge[120]. Dutch transporter Gasunie created a version of the national balancing point called the Title Transfer Facility (TTF). From January 5, 2004, Platts also assessed prices at this trading point.

Included in the estimating equation is a set of control variables that have been collected from various sources. The variables used in our analysis are described in Table 7.6 below, with the descriptive statistics reported in Table 7.7.

Table 7.6 Description of the variables

Variable	Description and source
Price	Hub price at time t for hub i. Measured in €/MWh
Treat	Treat dummy, 1 for Zee hub prices in BE and 0 for TTF hub price in NL
Post_1	Post dummy for date of decision (14 Nov 2006)
Post_2	Post dummy for time when remedies put in place (considered to be as at 30 June 2008)[121]
Post_3	Post dummy for when GDF Suez sold their remaining stake in Fluxys to Publigas + regulatory changes (considered to be as at 01 March 2010)
Temp	Corresponding temperature data for Belgium and the Netherlands. Sourced from national administrative bodies.
Tempsq	Quadratic temperature
Brent_crude_spot	Spot price for Brent crude oil as per Platts data place. Measured in $/bbl
Coal	Average daily price of coal. This is a combined price series of two sources (as used in case study 1) which measures the daily European reference

[120] Platts Zeebrugge gas assessments reflect prices at the so-called "Zeebrugge beach" interconnection point, rather than the virtual Zeebrugge Trading Point launched by the Belgian network operator in late 2012.

[121] We do not know the exact dates of the June 2008 remedies. In the same period (July 2008) the merger was finalized. We choose therefore an intermediate date (30 June) as our relevant treatment date, which should capture both the remedies and the finalization of the merger.

	price for coal imports into North-western Europe.
Power_prices	Daily price at the power exchange Sourced from Platts Database (BO_Platts_PX-daily_short_v01, same as dependent variable in case study 1). Since the Belgian Power Exchange (Belpex) started operating on 21 November 2006, there is no data for Belgium before 2007. As a result, Dutch power prices for 2005 and 2006 are used as a proxy for this time period[122].
Day_of_the_week	Dummy variable for the day of the week
Month	Dummy variable for month
Year	Dummy variable for year

Table 7.7 Descriptive statistics of the variables used in the estimation

Variable	Obs	Mean	Std. Dev.	Min	Max
Price	3,532	18.77	6.96	3.89	98.44
Treat	3,532	0.5	0.5	0	1
Post_1	3,532	0.73	0.44	0	1
Post_2	3,532	0.50	0.50	0	1
Post_3	3,532	0.26	0.44	0	1
Temp	3,532	10.77	6.47	-10.07	28.4
Brent_crude_spot	3,532	19.10	7.95	3.88	98.43
Coal	3,532	16.97	19.42	0.01	75.1
Power_prices	3,532	61.82	26.91	16.32	432.83

As one can see from Table 7.7 above, the high standard deviations and large differences between minimum and maximum of power prices – not only from gas, but also electricity oil and other power prices - show that prices are highly volatile. Therefore, only a DiD can really assess the impact of the merger and its remedies on hub prices.

Furthermore, apart from temperature, all other variables take on the value of 0 or 1, as they are treatment variables or before-after variables.

7.4.5 Additional estimation issues and robustness checks

As usual with high-frequency data, the estimation strategy has to deal with the issue of autocorrelation in the error term. We address this in three ways. First, we estimate our regressions with Newey-West standard errors, assuming heteroskedasticity and allowing for autocorrelation of the error term up to some lag. In our main specification the autocorrelation lag is 7, but we also use a 1-lag specification as a robustness check. Another usual way to deal with this issue is to estimate bootstrapped standard errors, something we also do as a robustness check. Finally, we reduce the frequency of data from daily to weekly. The results of these additional robustness checks are reported in Table A5.2-Table A5.4 in Annex 5.

Retrospective merger studies are faced with the task of correctly defining 'before' and 'after' periods. This task is often challenging because there might be both anticipation effects (i.e. strategic behaviours that may take place before the merger is approved) and delayed effects (i.e. it might take time before the merger is finalised, particularly if remedies have to be implemented).

One way to partially overcome this problem is excluding from the analysis a time window surrounding the merger. It is common practice in this literature to drop the data in the three-month or a six-month window surrounding the merger. This does not solve the problem

[122] It was tested to see if Dutch power prices were similar enough to Belgium, with the correlation between the two price series at later dates being very high (.93). This is deemed to be high enough to use as a proxy for this gap in the data series.

completely, as it may take years before the effects are realised. The same anticipation/delay effects might also be relevant for remedies too. In order to address this issue, for each of the three events a robustness check is done whereby a three-month window around the event is dropped. We further checked that our results are robust to different definitions of the time windows (one and six months). The results of these additional robustness checks are reported in Table A5.2-Table A5.4 in Annex 5.

Because we have long time series, we also estimate a specification with real prices rather than nominal prices. We also estimate a specification in logs, which should yield a more straightforward interpretation of coefficients. The results of these additional robustness checks are reported in Table A5.2-Table A5.4 in Annex 5.

7.4.6 Estimation results

We present here the results of the main set of estimations using the econometric framework described above. We show here two specifications for each treatment, one where the effect is measured from the exact day of each event, and one in which we drop a three-month window surrounding the event. In both regressions we estimate Newey-West standard errors with autocorrelation up to 7 lags. The results of all the additional regressions run as robustness checks described above are reported in Annex 5.

Individual Effects of the Merger Events

Presented here are three main sets of regressions; one for each definition of the 'post' period, corresponding to the three different events related to the merger.

In Table 7.8 estimation results are presented where the relevant event is the Commission's decision. As explained above, this regression is run on the period from January 2005 (beginning of our sample period) and June 2008 (date of event 2).

Table 7.8 Effect of the Commission's decision

VARIABLES	(1) Baseline	(2) Dropped time window
Treat	2.593***	2.930***
	(0.576)	(0.601)
post_1	1.339	-0.419
	(1.358)	(2.562)
Treat*post_1	**-2.364*** **	**-2.606*** **
	(0.586)	(0.611)
Observations	1,759	1,642

The dependent variable is the daily gas price at the hub. In both specifications we control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

The main coefficient of interest is the interaction coefficient *Treat*post*, which is negative and significant in both specifications**. This suggests that there was a price decline at the Belgian hub relative to the control hub after the decision. The result is slightly larger if a time window around the decision is excluded (column 2).** The positive coefficient for the *treat* dummy indicates that prices at the ZEE hub were on average higher than at the TTF hub over the period under consideration, controlling for the observable variables. The coefficient for the *post* dummy suggests that prices were not significantly different on average in the period after the decision with respect to the period before. The coefficients for the other control variables (not shown in the regression in the interest of space) generally have the expected signs, indicating a positive relationship with the prices of other inputs and a negative effect of temperatures.

The robustness checks shown in Table A5.2 in Annex 5 yield very similar results to those presented in Table 7.8. In particular, the coefficient of the interaction variable is still negative and very significant with real prices instead of nominal prices, with Newey-West with lower order of autocorrelation (lag 1), with bootstrapped standard errors, with smaller (1 month) or larger (6 months) time windows dropped around the event, and with weekly instead of daily data. It is worth noting that the larger the time window dropped around the event, the bigger the magnitude of the estimated effect, suggesting that the effect is smaller in the first months after the event.

We should also mention that the results shown in Table 7.8 might partly be driven by the large price movements that took place in the period prior to the merger decision. In order to test the sensitivity of our results to these price shocks, we run our regressions for event 1 on a reduced sample where we cut out the periods with the most extreme spikes (November 2005 and March 2006)[123]. The magnitude of the interaction coefficient becomes smaller but the sign is unchanged and still significant; this suggests that the size of the effect should be interpreted with some caution, but that prices went down in any case around the decision.

Table 7.9 below shows the results of the regressions that look at the effects of the 2008 events, namely the effective divestitures and the consummation of the merger. This regression is run on the period from November 2006 (date of event 1) and March 2010 (date of event 3).

Table 7.9 Effects of the 2008 events (effective divestitures of Distrigas, Distrigas & Co and partial divestitures of Fluxys; consummation of the merger)

VARIABLES	(1) Baseline	(2) Dropped time window
Treat	0.228***	0.216***
	(0.061)	(0.065)
post_2	0.255**	0.417***
	(0.101)	(0.110)
Treat*post_2	**-0.319*** **	**-0.377*** **
	(0.083)	(0.085)
Observations	1,660	1,540

The dependent variable is the daily gas price at the hub. In both specifications we control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

The coefficients of the treatment effect variable show that the events around June 2008 had a negative and significant impact on price at the ZEE hub, relative to our control hub. This finding holds true (and is even reinforced) if a window of three months around that date is dropped. Note that this is an additional price decrease with respect to the first one already produced after 2008. **This suggests that there was a price decline at the Belgian hub relative to the control hub after the effective implementation of the merger and associated remedies.** Also in this case, the results of the robustness checks (Table A5.3 in Annex 5) confirm the results of the baseline regressions, indicating that our estimations are pretty robust to changes in the specification.

Finally, Table 7.10 reports the result for the last set of regressions, which have March 2010 as the date of interest (i.e. when GDF Suez sold its remaining stake in Fluxys to Publigas). The sample period for these regressions is from July 2008 (date of event 2) until the end of 2011.

123 Note that results for event 2 and 3 are not affected by the price spikes since the sample period for these regressions does not include the period before 2007.

Table 7.10 Effect of GDF Suez's sale of its remaining stake in Fluxys

VARIABLES	(1) Baseline	(2) Dropped time window
Treat	-0.096	-0.097
	(0.058)	(0.061)
post_3	0.615***	1.175***
	(0.145)	(0.311)
Treat*post_3	**-0.105**	**-0.115**
	(0.074)	(0.078)
Observations	1,772	1,656

The dependent variable is the daily gas price at the hub. In both specifications we control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

The interaction coefficients of Table 7.10 are negative but not statistically significant, suggesting that the sale of the remaining stakes of GDF Suez in Fluxys led to a negligible reduction (if any) in hub prices. Note, however, that some of the alternative specifications shown in Table A5.4 in Annex 5 yield interaction coefficients that are weakly significant. In particular, if we use Newey-West with one lag instead of seven or bootstrapped standard errors the coefficient is significant at the 5 per cent level.

Total Effect of the Merger Events

We also estimate the total effect of the merger and of all associated remedies, assuming that this effect can only be observed when the last remedy has been implemented. We thus estimate the effect of the previously defined $post_3$ dummy and exclude the implementation period (December 2006 to February 2010) from the analysis. As in the three previous sets of estimations, we show in Table 7.11 a regression with Newey-West standard errors at the baseline specification, and also estimate a regression where we drop a three month window around the date[124].

Table 7.11 Overall effect of merger events

VARIABLES	(1) Baseline	(2) Dropped time window
Treat	2.571***	2.921***
	(0.572)	(0.595)
post_3	9.236**	6.903
	(4.334)	(4.261)
Treat*post_3	**-2.759*** **	**-3.111*** **
	(0.577)	(0.599)
Observations	1,873	1,744

The dependent variable is the daily gas price at the hub. In both specifications we control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

The interaction coefficients are negative and significant, which provides evidence that **the overall effect of the merger and of its associated remedies was a decrease in prices at the hub.** It is reassuring that the magnitude of the estimated overall impact is similar to the sum of the estimated individual effects of the three main events, suggesting that these were

[124] In this case we drop 45 days before event 1 and 45 days after event 3.

the main determinants of the merger effect (particularly the decision and the 2008 events). Other merger-related events might have played a role, but they do not seem to be of first-order importance in terms of realised effects on prices.

To test the sensitivity of these results to the price movements that occurred in the pre-merger period, we run the regression for the overall effect on a reduced sample where we drop the two months with the larger spikes, similarly to what we did for event 1. As expected, the interaction coefficients are smaller than those in Table 6.9, but still negative and significant. Another way to tackle the issue of price spikes is dropping the entire pre-merger period from the sample. We therefore evaluate the overall effect on a sample period that starts from 2007 (Table A5.3 in Annex 5). Here as well we find a negative and significant overall effect on prices, albeit smaller in magnitude than the one in Table 6.9.

7.5 Conclusions

The results of the empirical analysis suggest that the Commission's decision and the implementation of the merger and its associated remedies had an impact on wholesale gas prices in Belgium. Prices at the ZEE hub fell relative to the TTF hub around November 2006 and June 2008, and to a less extent around March 2010.

It is interesting that the first event (i.e. the Commission's approval of the merger subject to conditions) may have had the biggest effect. As argued above, one needs to be cautious of drawing implications from the magnitude of this coefficient since it might partly be due to the unusual price movements in the pre-merger period.

However, the finding of a large coefficient for the merger approval might suggest that there has been an anticipatory effect. In particular, since the implementation of the remedies and the consummation of the merger took quite some time, it is likely that at least some of the effects took place before officially the merger and remedy events occurred. This would imply that the effect of the merger decision might partly incorporate the effect of the following events. In this regard, it is also not surprising to find a very small effect for the last event, whose impact might have been largely anticipated by the market and therefore realised in advance.

As a whole, the evidence could suggest that the remedies were effective in limiting the potential anti-competitive effects of the merger, as the net effect of merger and remedies shows a price decline.[125] The estimated decline in prices, together with descriptive evidence of increased liquidity and traded volumes at the hub, also supports the view that ownership unbundling has generated better access to the hub[126]. In this respect, the remedies seem to have done more than simply mitigate the potential anti-competitive effects of the merger.[127]

These results are however, subject to the caveats explained above: (i) it is difficult to disentangle the effects of the different events related to the merger and the divestitures; (ii) the selection of the control group is not perfect, and (iii) other relevant events (in particular regulatory changes) that affected the functioning of the wholesale gas market and hubs might contribute to our results. One should therefore be cautious when drawing strong policy implications from this exercise.

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[125] It is not possible to disentangle the merger and the remedies, as they occurred around the same time. However, the net effect is informative of which effect dominated.

[126] One cannot totally exclude that price declines in principle indicate that the merger has led to efficiency gains, which in turn have led to price declines thereafter. However, this is more unlikely, given that no potential efficiency gains at the hub were indicated by the merging parties.

[127] Of course, one cannot exclude that other factors that are not related to the remedies have contributed to an increased access to the hub.

8 Overall conclusions of the study

This section summarises the key policy and methodological conclusions emerging from this study.

8.1 Policy conclusions

8.1.1 Q1. Can one observe a change in the functioning of energy markets in the EU over the past two decades?

The structure of European gas and electricity markets has fundamentally altered during the last two decades. Most electricity and gas markets in Europe were national (vertically integrated) monopolies until the 1990s, when the EU and its Member States decided to gradually open them up to competition and establish a common energy market. Nowadays, in most Member States, there is a separation between regulated (transmission and distribution) and competitive segments (production and retail). Significant progress has also been made towards energy market integration: many missing infrastructure links between EU countries have been built or are under construction; cross-border trade in gas and electricity between EU countries has increased; and wholesale prices are gradually converging.

Notwithstanding these achievements, gas and electricity markets across Europe continue to exhibit certain characteristics that are potentially harmful to competition, most notably:

- Electricity and gas markets are still very concentrated in both wholesale and retail segments, creating scope for incumbents to exercise market power.
- While progress has been made in liberalising markets, the positon varies across Member States. Many Member States continue to regulate end-user prices and there is still insufficient separation of infrastructure and supply functions in energy markets.
- Public ownership of the first generation producer remains high in many Member States in both gas and electricity markets.
- Gas and electricity prices have been rising for consumers (except in 2014 when prices fell) and high levels of mark-ups can be observed in a number of Member States
- There are significant price differentials for households across Member States, although energy prices for industrial consumers appear to be converging
- Switching levels are generally very low across Europe, with the exception of a handful of Member States.

How far the above features are actually adversely affecting competition cannot be determined here because this requires detailed investigations beyond the scope of the present study.

8.1.2 Q2. Can one observe a change in competition policy enforcement affecting energy markets in the EU over the past two decades?

There has been an increase in EU competition policy enforcement activity overtime and particularly since 2000 (when the first liberalisation directives were transposed in Member State legislation). As Table 8.1 shows, the number of cases handled by the Commission on an annual basis has significantly increased since 2000.

Table 8.1 Number of competition cases: electricity and gas sector

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	ND	Total
electricity	Anti-trust														1	2		1		1	1	1	7	14
	Anti-trust (Cartel)																					1		1
	Merger*	1	1	2	3	6	4	11	21	15	13	7	6	12	10	13	22	16	17	12	15	7		214
	sub-total	1	1	2	3	6	4	11	21	15	13	7	6	12	11	15	22	17	17	13	16	9	7	229
gas	Anti-trust									1		2			2		2	2				12		21
	Anti-trust (Cartel)																1					1		2
	Merger**	1		1	1	3		4	5	8	6	3	4	11	1	4	13	11	9	8	6			99
	sub-total	1	0	1	1	3	0	4	5	9	6	5	4	11	3	4	16	13	9	8	6	13	0	122
electricity + gas	Anti-trust	0	0	0	0	0	0	0	0	1	0	2	0	0	3	2	2	3	0	1	1	13	7	35
	Anti-trust (Cartel)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	3
	Merger	2	1	3	4	9	4	15	26	23	19	10	10	23	11	17	35	27	26	20	21	7	0	313
	sub-total	2	1	3	4	9	4	15	26	24	19	12	10	23	14	19	38	30	26	21	22	22	7	351

Source: DG COMP. Based on data extracted on 26/09/2014. NACE codes D35.1 and D35.2. By case end date.

Until 2003, merger cases in gas and electricity markets were more commonly handled under simplified procedures. Since 2003, a significantly higher share of the merger cases in gas and electricity markets have been subject to a full investigation, suggesting an increase in merger activity in these markets creating competition concerns.

EU merger control has been key to improving market structure and functioning by limiting further horizontal and vertical integration in energy markets, which are already highly concentrated. In some cases, the remedies put in place to mitigate the potential anti-competitive effects of a merger have also contributed to promoting market liberalisation (e.g. EnBW/ EdF case in 2001). In extreme cases, the Commission has prohibited anti-competitive mergers (e.g. the proposed acquisition of joint control over GDP by EDP in 2001), although such cases are rare.

Anti-trust enforcement in gas and electricity markets has predominantly focused on tackling three issues: exclusionary conduct by dominant incumbents; exploitative abuses by dominant incumbents; and collusive behaviour.

Overall, energy markets have been subject to increasing competition enforcement action over time.

8.1.3 Q3. Has the enforcement of competition policy in the energy sectors contributed to better functioning energy markets? To what extent?

We compiled several pieces of evidence to provide a broad picture of the different channels through which competition policy enforcement affects the functioning of energy markets. Specifically, we analysed the impact of competition policy on measures of competition - the elasticity of relative profits with respect to relative costs (Boone's indicator) and productivity dispersion - and the effect of completion policy enforcement (through the competition channel) on outcomes such as investment, and ultimately productivity. We also sought to capture both direct and indirect effects of the policies i.e. not only the impact of policy decisions on the firms that are involved, but also on other firms in the same market, plus potential spill-overs and deterrence effects into other (national) markets.

We found that EU merger control has had a robust positive and significant effect on the functioning of energy markets. Specifically, our analysis shows that the EU merger control has lowered both Boone's beta (elasticity of relative profits with respect to relative costs) and productivity dispersion, thereby indicating that national energy sectors became more competitive after these interventions. EU merger control is also related to higher investment and higher total factor productivity. These findings are consistent with the reasoning that EU merger policy actions - through the channel of competition - induce energy firms to invest more, which ultimately leads to higher productivity.

Impacts of antitrust enforcement and State aid control are much less clear cut. This does not necessarily imply that these interventions were less effective. This result could reflect the limitations of empirical analysis: State aid and antitrust cases were fewer in number as compared to merger cases and it is possible that their limited frequency did not allow us to empirically identify consistent relationships.

Although generalisations are not possible on the basis of a single case study, the E.ON antitrust case does illustrates the positive impact of EU antitrust enforcement on German electricity markets. In this particular case, the Commission investigated E.ON's alleged abuse of its dominant position on the German wholesale market in 2008, as discussed earlier.

We empirically examined the impact of the Commission's Decision on wholesale electricity prices, using daily data on peak and off-peak prices from the EEX. The results show that the Commission's Decision, by affecting competition in the EEX, led to a reduction in wholesale electricity prices in Germany. To determine if wholesale price reductions were eventually passed on to consumers by electricity suppliers, an extended analysis of retail electricity prices was undertaken using highly disaggregated data (monthly data at zip code level) purchased from the German price comparison website, Verivox. The results suggest that the Commission's Decision - by reducing market power upstream and hence, reducing wholesale prices – might have also contributed to reducing prices downstream.

We also empirically evaluated the price effects of a merger case. The GDF/Suez merger finalised in July 2008, which aimed to create one of the world's largest energy companies, would have, as originally planned, weakened competition in the gas and electricity wholesale and retail markets in Belgium and in the gas markets in France with the disappearance of competition between GDF and Suez in markets. Our case study demonstrates that the remedies offered by GDF and Suez were not only effective in limiting the potential anti-competitive effects of the merger (in Belgian wholesale gas markets which were the focus of study), but additionally, ownership unbundling, might actually have improved access to the hub.

The broader econometric analysis together with the two case studies provides a consistent picture of positive impact of EU competition policy enforcement. Specifically, the two case studies show that commitments and remedies can be effective tools for addressing potential anti-competitive behaviour or effects and thus, improving the functioning of markets.

8.1.4 Q4. Is there complementarity (in terms of objectives and effects) between competition and regulatory policies affecting the functioning of the energy markets? To what extent have we observed an increase in complementarity over the past two decades? Please explain

Regulation and competition policy can be complementary in several ways. The two can work together to support new entrants and smaller rivals in markets with an entrenched incumbent. Regulation is *ex-ante* and can provide certainty and facilitate market entry (by helping firms make forward-looking investment and production decisions). The facilitation of entry and promotion of effective rivalry creates the environment for more effective competition. The tools available to regulators and competition authorities could also generate complementarity. If extensive and/or frequent intervention is necessary, or where the remedies available to competition authorities are insufficient to address such conduct, regulation may be preferable. Competition law, on the other hand, typically has stronger powers to address anticompetitive behaviour.

It was not possible to carry out in-depth analysis of complementarities between competition policy and regulation within the scope of this study. Our broad econometric analysis (presented in section 4) examined the interplay between competition policy enforcement and regulation in energy markets. It shows that competition policy enforcement is more effective in liberalised markets as compared to markets that continue to be highly regulated. This supports the view that competition policy is mostly effective in markets where competition is not substituted by heavy regulation (as measured by the degree of entry regulation, public ownership, vertical integration and market structure).

There is however, the counter-argument that the impact of competition policy interventions can sometimes be stronger in highly regulated markets. For example, in countries where energy companies are vertically integrated or monopolised, anti-trust interventions to avoid market foreclosure and abuse of dominance can be important tools.

In practice, the Commission has been using instruments of competition policy enforcement together with regulation to promote reforms aimed at market liberalisation to improve the functioning of energy markets.

For instance, the Commission adopted the first liberalisation directives in 1996 (electricity) and 1998 (gas) to open up heavily regulated and monopolised national energy markets.

The *1996 Directive on Common Rules for the Internal Market in Electricity* (96/92/EC) was the first attempt to create an internal electricity market in the EU. The Directive established minimum regulations for achieving a 'comparable level of opening-up' in each Member States' electricity market. Each Member State was then required to choose the specific model of operation and regulation. It specifically creates rules in five areas: generation, retail supply, transmission & distribution, unbundling, and regulation.

The *1998 EU Gas Directive* (98/30/EC) was the analogous legislation for the gas market. The aim of the legislation was to open the gas market across the EU. It imposed responsibilities in the construction of major gas facilities, transmission & distribution, unbundling, and regulation.

A second round of liberalisation directives was agreed in 2003 and by 2007 all its provisions had entered into force.

Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC . The Directive established common rules for the generation, transmission and distribution of electricity. It laid down the rules relating to the organisation and functioning of the electricity sector, access to the market, the criteria and procedures applicable to calls for tenders and the granting of authorisations and the operation of systems.

Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC. The Directive established s common rules for the transmission, distribution, supply and storage of natural gas. It laid down the rules relating to the organisation and functioning of the natural gas sector, access to the market, the criteria and procedures applicable to the granting of authorisations for transmission, distribution, supply and storage of natural gas and the operation of systems.

Following the 2007 Sector Inquiry the Commission adopted the Third Energy Package to address some of the concerns highlighted in the Inquiry (e.g. insufficient unbundling and lack of cross border integration).

Repeated attempts at liberalisation, however, have had uneven success and competition has been slow to take off. The Commission has therefore been using the full range of competition policy tools at its disposal to improve the functioning of energy markets. For example, alongside regulation, the Commission has been using competition policy tools to promote unbundling and market liberalisation (e.g. GDF/Suez case, EdF/EnBW case).

8.1.5 Q5. Do competition case investigations and case decisions affect the design of sector regulations and the enforcement of such regulations?

Detailed qualitative research is required to answer this question comprehensively, and was beyond the scope of this study. However, it provides some evidence. The GDF Suez merger is an example where a specific competition case affected the design of sector regulations and the enforcement of such regulations at a national level. In this particular case, the merger remedies led to ownership unbundling in the Belgian gas market. In addition to this, a number of regulatory changes were enforced by the Belgian regulator, CREG, as a follow-up to the merger remedies.

- The merger remedies were largely supported by the national regulator CREG, who was also involved in their implementation. This empowered CREG to further push and bargain for more regulatory changes in the Belgian gas market as described above. In particular, the transfer of Fluxys and remaining assets underlying the physical structure of the Belgian gas market (such as transit, transmission, hub, LNG and storage) were essential for simplifying access to the Belgian gas markets. Thus, merger remedies made regulatory changes on national level easier to implement.

- In addition, to improve the functioning of its markets, it implemented a better congestion management of the network, reduced the number of balancing zones to one (instead of four) and new rules of conduct.
- The part of the E.ON case not discussed (the balancing market) also sheds light on this issue because E.ON was forced to sell (unbundle) is balancing network.

At a European level, the Third Energy Package was designed to address some of the competition concerns identified by the 2007 Sector Inquiry. In this case, sector regulations were directly influenced by competition policy enforcement.

8.2 Methodological reflections

In this study we used different methodological tools to analyse the effectiveness of competition policy interventions. This is because of the array of questions needing answers. We were interested in analysing the broad impact of a large set of interventions - EU competition policy, national competition policy, and regulation - and their interactions on more firms active in different geographical markets (as energy markets still largely operate nationally). But while such an analysis potentially presents the ‘big picture’, the drawback is that the level of aggregation prevents clean answers to important details and specific questions.

We therefore used case studies to analyse single decisions. While this allows us to be more precise in modelling the peculiarities of relevant product and geographic markets and to carry out a more detailed and granular analysis of the causal effects of specific competition policy enforcement decisions, the results of individual cases cannot be generalised.

The methods proposed should be seen as complementary and designed to answer related, but not entirely overlapping questions. A first important conclusion is that each research question or policy question requires a specific method. Therefore, each particular result can be seen as a piece of the puzzle. A sound evaluation exercise requires several of these pieces to be put together in a coherent and convincing way.

While this study managed to stay close to this approach, the substantial issue of resource constraints should be noted. A large team of experts produced four separate empirical analyses, based on different data sources and empirical frameworks with a limited budget and within a tight timetable (less than 12 months). This inevitably imposed certain limitations on the depth and breadth of analysis undertaken.

A common element of all the approaches is our belief that a sound evaluation can only be performed by carefully using quantitative methods based on solid and objective databases. Qualitative analysis can help enrich the quantitative results and build a coherent framework. But it cannot stand alone. So although the proposed approaches vary, there are several common elements worth discussing in more detail: i) data availability, ii) identification/causality, and iii) robust inference.

8.2.1 Data availability

All different empirical analyses are based on the use of rich micro data from various sources. The issue of data availability and data collection is key to any evaluation exercise. The quality of the data strongly influences the choice of the cases evaluated, the specific econometric approach, and the identification strategy. Good and rich data also enable more careful and precise inferences. Although we collected exceptionally good data for the different empirical analyses, in each chapter we faced constraints due to data availability. Data is rarely freely available and commercial data is generally expensive. A clear lesson is that a budget for data acquisition should be allocated to such a project.

Great care time has to be dedicated to understanding the research question and its specificities and choosing the appropriate data. This first step strongly influences the quality of the subsequent analysis.

In the broad econometric analysis, for example, we worked hard to collect reliable, disaggregated and comparable data on competition policy enforcement both at EU and national levels. Given the limited variation in the data, however, we had to aggregate this rich information to be able to use it in an econometric exercise. This allowed us to generate findings easy to interpret but did not allow us to fully identify channels through which policy enforcement affected outcomes.

Limited variation in the data did not allow us to make clear inference on some dimensions of policy enforcement. We did not find statistically significant effect for some variables, which could be due to the quality of the data, not necessarily because of the absence of true effects. There were similar issues to constructing some of the outcome variables. While we wanted to keep the aggregation level as low as possible to define product markets adequately, data constraints made this impossible. To construct rich outcome measures, such as productivity and relative profit elasticity to relative cost, we also needed information on several firms' characteristics that was only partially available, even though we had (costly) access to one of the richest firm-level datasets that currently exists.

Data availability was less of an issue in the E.ON case study. Both for the German wholesale and retail electricity markets, we were able to compile very rich databases. These were expensive. While the available datasets were rich compared to other studies, we had to make some methodological choices because of data constraints. For example, regardless of our efforts to collect a rich dataset for several European countries involving information on wholesale prices and their drivers, this information was not good enough to create a reliable synthetic control group for the German wholesale markets. We therefore had to adapt our identification strategy.

Data availability was a major issue in the GDF Suez case. Gas markets, compared to electricity markets, are less transparent and, to some extent, present more complex issues. Substantial effort and resources were spent to discuss data access with several stakeholders (regulators and firms). Data availability has been such a critical issue throughout that while we were finally able to carry out some empirical analysis, data restrictions forced us to concentrate on only one part of the affected market.

8.2.2 Identification and causality

Relatedly, the second major issue of any evaluation study is the ability to identify causal relationships. Identification is the key methodological question of any econometric model. For a sound policy evaluation, it is crucial to be able to conclude that exactly that specific intervention was causing that specific outcome. It is therefore vital to be able to exclude that other omitted factors were the explanation for the empirical findings.

In every chapter, we worked to make our identification strategy as clean and as transparent as possible. In some cases, for example in the broad econometric analysis, it was impossible to make strong causality claims. However, the findings can still be carefully interpreted as 'controlled correlations'. The focus on heterogeneous effects can also help to improve this interpretation. For example, because we observe competition policy enforcement to be more effective in countries that are less regulated helps to attach a causal interpretation to the results: competition policy cannot be particularly effective in markets where firms are not freely competing, but are regulated by state intervention. But because such analysis is expected to have significant policy implications, it is important to be honest about the extent of the conclusions.

The issue of identification is also related to the level of aggregation and the quality of the data. The more 'micro' the level of analysis, the more likely specific peculiarities of the case(s) or market(s) under consideration can be exploited to develop a clean identification strategy. Specifically in the two case studies, we were able to more cleanly identify causal effects by focusing on a difference-in-difference methodology tailored to the specificities of the case. The basic idea of this methodology, which is the most popular identification strategy in evaluation studies, is to look at the outcome of a group affected by an intervention and compare it to the outcome of a control group.

The variation over time in the outcome variable is then used to establish what would have occurred in the absence of the intervention. Such an approach is powerful and appropriate when looking at single decisions, but cannot be adopted to evaluate a large policy programme because there is more than one policy intervention (treatment) to be analysed and therefore, it is impossible to define a good counterfactual.

Even in a case study, data availability and the peculiarity of the analysed markets are key determinants in the choice of counterfactuals or control groups. The best possible scenario is when regional variation is available. Comparing different regions of the same country has the advantage to control for common unobservable institutional drivers. However, it is then necessary that the policy under investigation has a heterogeneous effect across regions. We were only able to fully exploit this regional variation in the analysis of the effect of the E.ON decision on the German retail markets. .

In this case, where cross-sectional variation was limited, the identification strategy was more theoretically driven. For example, in the German wholesale electricity market, we knew in theory that firms have more market power during peak-times as demand for electricity is much stronger than during off-peak times and the supply schedule is very concave. This knowledge provided a prediction based on the difference between only two groups. In absence of regional variation, as in the case of the German wholesale electricity market, we based our identification on within-country variation between peak and off-peak prices.

Alternative approaches can be based on cross-country variation, for example to estimate ‘placebo effects’. For the wholesale analysis in the E.ON case, we used data from the French and Spanish market as placebos. We tested whether the results obtained for Germany and attributed to the Commission’s decision could also be seen in these markets which should not have been affected - or at least much less - than Germany. To discover this was not the case strongly supported our identification strategy.

Cross-country variation can be also used to create control groups. A first approach relies on the creation of a so-called synthetic control group, consisting of a hypothetical market, whose outcome pre-treatment is an almost perfect match for the outcome of the treated group.

We attempted this approach in the E.ON case where this ‘synthetic group’ was constructed as a weighted average from a selection of other countries and represents Germany as it would be, had it not been treated by the policy decision. Unfortunately, because of the data limitation, we could not create a satisfactory synthetic control group so abandoned this approach. We do believe, however, that this is promising approach to make causal inference in presence of a large cross-section of non-treated observations.

Finally, cross-country variation can be used to simply compare the treated country to a single other country. This approach is perhaps not the perfect choice, because in some cases it could be difficult to identify another national market that can be truly compared to the treated one or to control for all the events that might impact the outcomes of both treated and control countries.

Direct neighbouring countries might also be a poor counterfactual if national markets are becoming more integrated, as in the electricity sector and, to a lesser extent, the gas sector. However, data availability constraints and market characteristics can mean there is no alternative to this simpler cross-country comparison. This was the case for the GDF Suez merger, where the only viable strategy was to compare prices in the Belgian gas hub to those in the Dutch gas hub. Fortunately, in this case, the high-frequency time-series dimension of the data partially compensated for some of the drawbacks discussed above because it allowed more focus on identifying specific implementation of several parts of the decision.

8.2.3 Robust Inference

We believe that the last important step in a policy evaluation exercise is to provide evidence of the robustness of the inference provided. This involves two main issues: the assumptions on the stochastic part of the model, i.e., the error terms and, more generally, the other model’s assumptions.

The first issue is crucial since assumptions on the error term affect the estimation of the standard errors and therefore the statistical significance of the results. Interestingly, problems of heteroskedasticity, autocorrelation, and within-panel-correlation play a major role for inference, particularly when the quality of the data is high. But in these cases, the possibility of providing robustness checks is also much larger. In all our empirical exercises we tried to motivate and support our assumptions on the error terms. Particularly for the case studies where we had high frequency time-series data, we provided several robustness checks based on different assumptions on the standard errors.

A convergence of findings obtained with different assumptions provides strong additional confidence on the quality of the results. We consider this an important lesson of this study: there is often no perfect modelling assumption and the only way to deal with this issue is to estimate different versions of the model and provide evidence that the main results are robust to this model's perturbations.

Similarly, such robustness checks can be more generally used to provide additional empirical support for specific identification assumptions, discussed in the 'placebo tests' above, or to provide a broader picture, as in the econometric analysis where we examine different outcome variables to understand whether the effect of the policy was consistent along these different dimensions. Overall, robustness checks, when they generate consistent results, are vital to assess causal relationships and therefore to policy evaluation.

ANNEXES

Annex 1 References

Adams, W.J. and Yellen, J.L. 1976. 'Commodity Bundling and the Burden of Monopoly'. Quarterly Journal of Economics. 90: 475-498.

Aghion, P. and Griffith, R. 'Competition and growth: Reconciling Theory and Evidence'. Zeuthen Lectures, MIT Press.

Aghion, P. and Schankerman, M. 2004. 'On the Welfare Effects and Political Economy of Competition-Enhancing Policies'. Economic Journal. 114: 800-824.

Aghion, P., Bloom, P. N., Blundell, R. and Griffith, R. 2005. 'Competition and Innovation: An Inverted-U Relationship'. Quarterly Journal of Economics. 120: 701-728.

Aguzzoni, L., E. Argentesi, L. Ciari, T. Duso and M. Tognoni. 2013. 'Ex-post merger evaluation in the UK retail market for books'. DiW Discussion Paper 1310.

Ahn, S. 2002. 'Competition, Innovation and Productivity Growth: A review of theory and evidence'. OECD Economics department Working Papers No. 317.

Alesina, A., Ardagna, S., Nicoletti, G. and Schiantarelli, F. 2005. 'Regulation and investment'. Journal of the European Economic Association. 3(4): 791-825.

Amir, R. (2002) Market structure, scale economies and industry performance

Anderson, J. 1999. 'Making Operational Sense of Mergers and Acquisitions'. Electricity Journal. Aug-Sept: 49-59.

Anderson, S.P. and Leruth L. 1993. 'Why firms prefer not to price discriminate via mixed bundling'. International Journal of Industrial Organization. 49-61.

Arellano, M. and Bover, O. 1995. 'Another Look at the Instrumental Variable Estimation of Error-Components Models'. Journal of Econometrics. 68: 29-52.

Arellano, M. and S. R. Bond. 1991. 'Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations'. Review of Economic Studies. 58: 277-297.

Armstrong, M. and Vickers, J. 2008. 'Competitive nonlinear pricing and bundling'. Review of Economic Studies. 77: 30-60.

Barquin, J., Bergman, L., Crampes, C., Green, R., van Hirchhausen, C., Leveque, F. and Stoft, S. 2006. 'The Acquisition of Endesa by Gas Natural: Why the Antiturst Authorities are Right to Be Cuations'. Electricity Journal. Mar: 62-68.

Becker-Blease, J.R., Goldberg, L.G. and Kaen, F.R. 2004. 'Post-Deregulation Restructuring of the Electricity Power Industry: Value Creation or Value Destruction?'. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstracts_id=625083

Besley, T. and Case, A. 2000. 'Unnatural Experiments? Estimating the Incidence of Endogenous Policies'. Economic Journal. 110: 672-694.

Blundell, R. and Bond, S. 1998. 'Initial Conditions and Moment Restrictions in Dynamic Panel Data Models'. Journal of Econometrics. 87(1): 115-143.

Böckers, V. and Heimeshoff, U. 2014. 'The extent of European power markets'. Energy Economics (forthcoming).

Bolle, F. and Breitmoser, Y. 2006. 'On the Allocative Efficiency of ownership unbundling'. European University Viadrina Frankfurt (Oder) Department of Business Administration and Economics Discussion Paper No. 255.

Boone, J. 2008. 'A New Way to Measure Competition'. The Economic Journal. 118: 1245-1261.

Borenstein, S. and J. Bushnell. 1999. ‘An Empirical Analysis Of The Potential For Market Power In California's Electricity Industry’. The Journal Of Industrial Economics. 47(3): 285 323.

Borenstein, S., Bushnell, J. and Wolak, F. 2002. ‘Measuring market ienfficiencies in California’s restructured wholesale electricity market’. American Economic Review. 92(5): 1376-1405.

Brau, R., Doronzo, R., Riorio, C. and Fiorio, M. 2010. ‘EU gas industry reforms and consumer’s prices’. Energy Journal. 31(4): 167-182.

Buccirossi, P., Ciari, L., Duso, T., Spagnolo, G., & Vitale, C. 2013. ‘Competition policy and productivity growth: an empirical assessment’. Review of Economics and Statistics. 95(4): 1324-1336.

Bulow, J. and Klemperer, P. (1999) Prices and the winner’s curse, RAND Journal of Economics, vol. 33 (1), pp. 1–21.

Bushnell, J., Mansur, E.T. and Saravia, C. 2005. ‘Vertical arrangements’. Market structure and competition: An analysis of restructured US Electricity Markets. 126.

Chao, H., Oren, S., and Wilson, R. (2005). Restructured Electricity Markets: Reevaluation of Vertical Integration and Unbundling. Technical paper, EPRI

Chaton, C., Gasmi, F., Guillerminet, M.L. and Oviedo, J.D. 2010. ‘Gas Release and Transport Capacity Investment as Instruments to Foster Competition in Gas Markets’. TSEWP Working paper series 10-203.

Christiansen, L., Jorgenson, D. and Lau, L. 1972. ‘Transcendental logarithmic production function’. Review of Economics and Statistics. 54: 28-52.

Commission de la Régulation de l’Énergie (CRE). 2010. ‘The French wholesale electricity and natural gas markets: 2009-2010 Report’. Available at: http://www.cre.fr/en/documents/publications/thematic-reports/the-french-wholesale-electricity-natural-gas-and-co2-markets-in-2009-2010

Competition & Markets Authority (2015) Productivity and competition, A summary of the evidence, CMA45

Copenhagen Economics. 2005. ‘Market Opening in Network Industries: Part Two: Sectoral Analysis’. Copenhagen Economics for DG Internal Market.

CREG. 2006. ‘Study on the planned merger between Gaz de France and Suez’. Undertaken in application of Article 23, paragraph 2 of the law of 29 April 1999 on the organisation of the electricity market and Article 15/14, 2, paragraph 2 of the law of 12 April 1965 on the transmission of gaseous and other products by pipeline.

Cremer, H., Cremer, J. and De Donder, P. 2006. ‘Legal Vs Ownership Unbundling in Network Industries’. CEPR Working Paper No. 5767.

Cusack, T. and Fuchs, S. 2002. ‘Documentation Notes for Parties, Governments, and Legislatures Data Set’. Wissenschaftszentrum Berlin für Sozialforschung, mimeo.

Doane, M.J. and Spulber, D.F. 1994. ‘Evolution of the U.S. Spot Market for Natural Gas. Journal of Law and Economics. 38(2).

Duso, T. 2005. ‘Lobbying and Regulation in a Political Economy: Evidence from the U.S. Cellular Industry’. Public Choice. 122(3-4): 251-276.

Duso, T. and Röller, L.H. 2003. ‘Endogenous Deregulation: Evidence from OECD Countries’. Economics Letters. 81: 67-71.

Duso, T. and Seldeslachts, J. 2010. ‘The Political Economy of Mobile Telecommunications Liberalization: Evidence from the OECD Countries’. Journal of Comparative Economics. 38: 199-216.

Economides N. 1993. ‘Mixed bundling in duopoly’. Discussion Paper EC-93-29. Stern School of Business NYU.

Fabra, N. and Toro, J. 2005. ‘Price wars and collusion in the Spanish electricity market’. International Journal of Industrial Organization. 23: 155-181.

Federico, G. 2011. ‘The competition effects of energy mergers: Analysis of Europe and Spain’. IESE Business School Occasional Paper Series.

Fiorio, C.V. and Fliorio, M. 2009. 'The reform of network industries, privatization and consumers' welfare; evidence from the EU15'. Working Paper n 2009-41. Available at: http://wp.demm.unimi.it/tl_files/wp/2009/DEMM-2009_041wp.pdf

Friberg, R. and Romahn, A.. 2013. 'Divestiture Requirements as a Tool for Competition Policy: A Case Study from the Swedish Beer Market'.

Grajek, M. and Röller, L.H. 2012. 'Regulation and investment in network industries: Evidence from European telecoms'. Journal of Law and Economics. 55(1): 189-216.

Granier, L. and Podesta, M. 2010. 'Bundling and Mergers in Energy Markets'. Energy Economics, Elsevier. 32(6): 1316-1324.

Granitz, E. and Klein, B. 1996. 'Monopolization by 'Raising Rivals' Costs': The Standard Oil Case'. Journal of Law and Economics. 39(1).

Griffith, R., Redding, S. and van Reenen, J. 2004. 'Mapping the two Faces of R&D: Productivity Growth in a Panel of OECD Industries'. Review of Economics and Statistics. 86: 883-895.

Growitsch, C. and Stronzik, M. 2009. 'Ownership unbundling of gas transmission networks – theoretical background and empirical evidence'. Papier für die Jahrestagung 2009 des Vereins für Socialpolitik, Magdeburg.

Guan, W. 2003. 'From the help desk: bootstrapped standard errors'. The Stata Journal. 3(1): 71-80.

Gugler. K., Rammerstorfer, M., Schmitt, S. 2013. 'Ownership unbundling and investment in electricity markets — A cross country study'. Energy Economics 40: 702-713.

Guthrie, G. 2006. 'Regulating Infrastructure: The Impact on Risk and Investment'. Journal of Economic Literature, American Economic Association. 44(4): 925-972.

Handbook of Industrial Organization, Vol. I, Amsterdam: Elsevier Science Publishers

Hastings, J. S. 2004. 'Vertical relationships and competition in retail gasoline markets: Empirical evidence from contract changes in Southern California'. American Economic Review. 94(1): 317-328.

Hattori, T. and Tsutsui, M. 2004. 'Economic impact of regulatory reforms in the electricity supply industry: a panel data analysis for OECD countries'. Energy Policy. 32(6): 823-832.

Hausman, J. 1997. 'Valuation of New Goods under Perfect and Imperfect Competition' In Bresnahan, T. and Gordeon, R., eds., 'The Economics of Goods'. University of Chicago Press, Chicago: 209-237.

Hausman, J. 2001. 'Mismeasured variables in econometric analysis: problems from the right and problems from the left'. The Journal of Economic Perspectives. 15(4): 57-67.

Hauteclocque and Glachant (2008),

Hauteclocque, A. and Glachant, J.M. (2008) Long-term Energy Supply Contracts in European Competition Policy: Fuzzy not Crazy,

Heather, P. 2012. 'Continental European gas hubs: are they fit for purpose?'. Oxford Institute for Energy Studies Working Paper. NG 63.

Helm, D. 2014. 'What future for vertically integrated energy companies?'. Accessed 17 September 2014 at http://www.dieterhelm.co.uk/sites/default/files/What%20future%20for%20vertically%20integrated%20energy%20companies.pdf

Höffler, F. and Kranz, S. 2011. 'Imperfect legal unbundling of monopolistic bottlenecks'. Journal of Regulatory Economics. 39(3): 273-292.

Holmes, T. and Schmitz, J. (2010),'Competition and Productivity: A Review of Evidence', *Annual Review of Economics*, Vol.2, 619-642

Hunger, D. 2003. 'Analyzing gas and electric convergence mergers: A supply curve is worth a thousand words'. Journal of Regulatory Economics. 24(2): 161-173.

Hvid, M. and Waddams Price, C. 2012. 'Non-Discrimination Clauses in the Retail Energy Sector'. The Economic Journal. 122(562): F236-F252.

International Gas Union. 2014. ‘Wholesale Gas Price Survey, 2014 edition. A global review of price formation mechaisms 2005-2013’. Available at: http://www.igu.org/sites/default/files/node-document-field_file/IGU_GasPriceReport%20_2014_reduced.pdf

Joskow, P.L. 2002. ‘Transaction Cost Economics, Antitrust Rules, and Remedies’. Journal of Law, Economics and Statistics. 19: 95-116.

Khan, E. 1998. ‘Numerical Techniques for Analyzing Market Power in Electricity’. The Electricity Journal. 98: 34-43.

Kingermann, H.D., Bara, J., Budge, I., Macdonald, M. and Volkens, A. 2006. ‘Mapping Policy Preferences II: Estimates for Parties, Electors and Governments in Central and Eastern Europe, European Union and OECD, 1990–2003.’. Oxford University Press.

Leveque, F. 2005. ‘L’Analyse du Pouvoir de Marché dans l’Electricit’. Competitions. 3: 28-32.

Leveque, F. 2006. ‘Antitrust Enforcement in the Electricity and Gas Industries: Problems and Solutions for the EU’. The Electricity journal. 19(5): 27-34.

Lichtenberg, Frank R., and Donald Siegel. 1991. ‘The impact of R&D investment on productivity–New evidence using linked R&D–LRD data’. *Economic Inquiry.* 29(2): 203-229.

London Economics. 2012. ‘Energy Retail Markets Comparability Study. A report for DECC’.

Martin, J.G. 2002. ‘Mergers and Other Corporate Combinations in the Natural Gas and Electricity Industries’. Energy and Mineral Law Foundation.

Massol, O. and Banal-Estanol, A. 2015. ‘Market power across the Channel: Are Continental European gas markets isolated?’. mimeo

Meyer, R. 2012. ‘Vertical economies and the cost of separating electricity supply – a review of theoretical and empirical literature’. Energy Journal. 33(4): 155-172.

Nalebuff, B. 2004. ‘Bundling as an Entry Barrier’. Quarterly Journal of Economics. 119(1): 159-187.

Nardi, P. 2010. ‘Transmission network unbundling and grid investments. Evidence from the UCTE countries’. Working Paper, Bocconi University.

Neuhoff, K. and de Vries, L. 2004. ‘Insufficient incentives for investment in electricity generations’. Utilities Policy. 12(4): 253-267.

Neuman, A., Hirschausen, C. and Siliverstovs, B. 2006. ‘Convergence of European sport market prices for natural gas? A real-time analysis of market integration using the Kalman Filter’. Applied Economics Letters. 13(11): 727-732.

Neuman, A., Hirschausen, C., Siliverstovs, B. and L’Hegaret, G. 2005. ‘International market integration for natural gas? A cointegration analysis of prices in Europe, North America and Japan’. Energy Economics. 27(4): 603-615.

Newbery, D. 2005. ‘Electricity liberalisation in Britain: the quest for a satisfactory wholesale market design’. The Energy Journal, International Association for Energy Economics. 26: 43-70.

Newbery, D. 2007. ‘What are the Issues in M&A arising from Electricity Market Restructuring?’.

Nikogosian, V. and Veith, T. 2012. ‘The impact of ownership on price-setting in retail-energy markets—The German case’. Energy Policy. 41: 161-172.

Ockenfels, A., Grimm, V. and Zoettl, G. 2008. ‘Strommarktdesign–Preisbildungsmechanismus im Auktionsverfahren für Stromstundenkontrakte an der EEX. Gutachten im Auftrag der European Energy Exchange AG zur Vorlage an die Säschsische Börsenaufsicht’.

OECD. 2013.’Product Market Regulation Database’. Available at: www.oecd.org/economy/pmr

Padilla, A.J., Polo, M., Schnitzer, M., Spector, D., Schmalensee, R. and Vives, X. 2005. ‘The proposed acquisition of Endesa by Gas Natural: Is there an academic consensus against electricity and gas mergers?’.

Parsons. 1989. ‘Estimating the Strategic Value of Long-Term Forward Purchase Contracts Using Auction Models’. *Journal of Finance*. 44(4): 981-1010.

Peitz, M. 2008. ‘Bundling May Blockade Entry’. International Journal of Industrial Organization. 26(1): 41-58.

Petrovich, B. 2013. ‘European gas hubs: how strong is price correlation?’. The Oxford Institute for Energy Studies. NG79.

Platts. 2014. European Natural Gas Assessments and Indices: Methodology and Specification Guide, available at: http://www.platts.com/IM.Platts.Content/MethodologyReferences/MethodologySpecs/eurogasmetho.pdf

Pollitt, M. 2008. ‘The arguments for and against ownership unbundling of energy transmission networks’. Energy Policy. 36(2): 704-713.

Pozzi, A. 2004. ‘Recent development and relevant issues in evolutionary economic and industrial dynamics’. Economia e Politica Industriale. 2004(123).

Reisinger M. 2008. ‘Product bundling and the correlation of valuations in duopoly’. Mimeo.

Rey, P. and Tirole, J. 2004. ‘A primer on foreclosure. In: Armstrong, M., Porter, R. (Eds.), In: Handbook of Industrial Organization, vol. 3. North Holland, New York’. pp2145–2220.

Rosenthal, R. (1980) A model in which an increase in the number of sellers leads to a higher price, Econometrica, vol. 48 (6), pp. 1575–9.

Rupérez-Micola, A., Banal- Estañol, A. and Bunn, D.W. 2008. ‘Incentives and coordination in vertically related energy markets’. Journal of Economic Behavior & Organization. 67(2): 381-393.

Sacco, Dario, and Armin Schmutzler. 2011. ‘Is there a U-shaped Relation between Competition and Investment?’. *International Journal of Industrial Organization*. 29(1): 65-73.

Sadowska, Małgorzata “Energy Liberalization in an Antitrust Straitjacket: A Plant Too Far?,” World Competition: Law and Economics Review, 2011, Vol. 34, Issue 3

Schmutzler, Armin. 2013. ‘Competition and investment—A unified approach’. *International Journal of Industrial Organization.* 31(5): 477-487.

Steiner, F. (2001). “Regulation, Industry Structure and Performance in the Electricity Supply Industry”, OECD Economic Studies No. 32.

Steiner, F. 2001. ‘Regulation, industry structure and performance in the electricity supply industry’. OECD Economic Sutides. 32: 143-182.

Stiglitz, J. (1989) Imperfect information in the product market, in R. Schmalensee and R. Willig, eds

Syverson, C. 2004. ‘Product substitutability and productivity dispersion’. Review of Economics and Statistics. 86(2): 534-550.

Verde, S. 2008. ‘Everybody merges with somebody – The wave of M&A’s in the energy industry and the EU merger policy’. Energy Policy. 36.3(2008): 1125-1133.

Waddams Price, C. 2005. ‘The Effect of Liberalizing UK Retail Energy Markets on Consumers’. Oxford Review of Economic Policy. 21(1): 128-144.

Whinston, M.D. 1990. ‘Tying, Foreclosure, and Exclusion’. American Economic Review. 80(4): 837-859.

Willems, B. 2006. ‘Virtula divestitures, will they make a difference? Cournot competition, option markets and efficiency’. Center for the Study of Energy Markets (CSEM) Working Pape Series (CSEM WP 150).

Windmeijer, F. 2005. ‘A finite sample correction for the variance of linear efficient two-step GMM estimators’. Journal of Econometrics. 126(1): 22-51.

Wolak, F. 2000. ‘An empirical analysis of the impact of hedge contracts on bidding behavior in a competitive electricity market’. International Economic Journal. 14(2): 1-39.

Wolak, F. 2003. ‘Measuring unilateral market power in wholesale electricity markets: the California market 998-2000’. American Economic Review, Papers and Proceedings. 425-430.

Woldendorp, J., Keman, H. and Budge, I. 2000. 'Party Government in 48 Democracies (1945–1998)'. Dordrecht: Kluwer.

Wolfram, C. 1998. 'Strategic Bidding In A Multi-Unit Auction: An Empirical Analysis Of Bids To Supply Electricity in England And Wales'. Rand Journal of Economics. 29(4): 703-725.

Wolfram, C. 1999. 'Measuring Duopoly Power In The British Electricity Spot Market'. American Economic Review. 89(4): 805-826.

Zachmann, G. and Von Hirschhausen, C. 2008. 'First evidence of asymmetric cost pass-through of EU emissions allowances: Examining wholesale electricity prices in Germany'. Economic Letters. 99(3): 465-469.

Annex 2 Descriptive analysis: overview of key trends

A2.1 EU Electricity market – time trends

Table A2.1 Market concentration over time – EU average (standard deviation across Member States in brackets)

Year	Electricity generation – HHI	Wholesale – change in players	Retail - HHI	Retail – CR3
2000	n.a.	n.a.	n.a.	n.a.
2001	n.a.	n.a.	n.a.	n.a.
2002	n.a.	n.a.	n.a.	n.a.
2003	n.a.	n.a.	n.a.	n.a.
2004	n.a.	n.a.	n.a.	84.79 (26.94)
2005	5,157 (3,197)	n.a.	n.a.	81.56 (26.76)
2006	5,060 (3,202)	n.a.	n.a.	77.55 (25.51)
2007	4,986 (3,197)	n.a.	n.a.	80.00 (23.71)
2008	4,938 (3,212)	n.a.	n.a.	80.79 (22.03)
2009	4,833 (3,175)	15.33% (27.28)	n.a.	78.77 (22.22)
2010	4,679 (3,139)	28.90% (90.92)	n.a.	78.64 (21.07)
2011	4,504 (3,089)	4.54% (17.68)	3,493 (2,631)	78.33 (20.18)
2012	4,316 (2,958)	30.05% (129.60)	n.a.	75.95 (19.57)
2013	4,229 (2,901)	18.89% (83.34)	4,359 (3,103)	73.35 (20.97)

Table A2.2 Market concentration over time – by Member State

Member State	Electricity generation (HHI)		Wholesale (change in players)		Retail (CR3, HHI time trend not available)	
	2007	Change since 2007	2009 – latest available	Change since 2009	2007	Change since 2007
Belgium	6,397	-2,614	n.a.	n.a.	64	-7.00
Bulgaria	3,583	-933	n.a.	n.a.	n.a.	22.2
Cyprus	10,000	-444	-	-	97.5	-48.5
Czech Republic	4,917	-870	50.00	- 50.00	100	-2.19
Denmark	2,859	-619	-	-	100	0
Germany	1,188	86	0.65	4.35	99	-29
Estonia	9,128	-1,928	-	- 10.71	n.a.	0
Ireland	3,494	-953	- 5.00	9.17	99	0
Greece	7,942	-3,613	- 1.39	- 2.67	40	0
Spain	1,680	-157	1.13	425.90	94	-10
France	7,992	-1,539	-	10.41	46.1	-0.6

Member State	Electricity generation (HHI)		Wholesale (change in players)		Retail (CR3, HHI time trend not available)	
Croatia	9,910	-1,182	17.65	- 20.77	n.a.	
Italy	2,338	-810	54.05	- 54.05	100	-0.28
Cyprus	10,000	-444	35.71	- 40.06	87.18	-0.76
Latvia	9,176	-79	-	-	85	-1.7
Lithuania	7,104	-1,761	8.00	3.48	60	-13.8
Luxembourg	5,548	-363	-	33.33	100	-1
Hungary	1,831	320	50.00	- 46.92	100	-47
Malta	10,000	-690	- 23.08	4.90	93	3
Austria	1,936	-143	-	-	100	0
Poland	1,866	-167	14.29	16.27	n.a.	-0.6
Portugal	4,958	-1,111	12.00	- 90.25	44.9	22.46
Romania	2,092	-611	50.00	- 36.84	99.6	-14.1
Slovenia	5,791	-399	8.70	9.19	44	14
Slovakia	6,227	-327	14.20	27.17	35	29.55
Finland	1,308	-144	8.33	-	68	-10.9
Sweden	2,955	-177	106.67	- 127.23	83.9	-12.47
The Netherlands	1,384	-159	- 3.23	4.88	n.a.	n.a.

Figure A2.1 Retail electricity prices – households

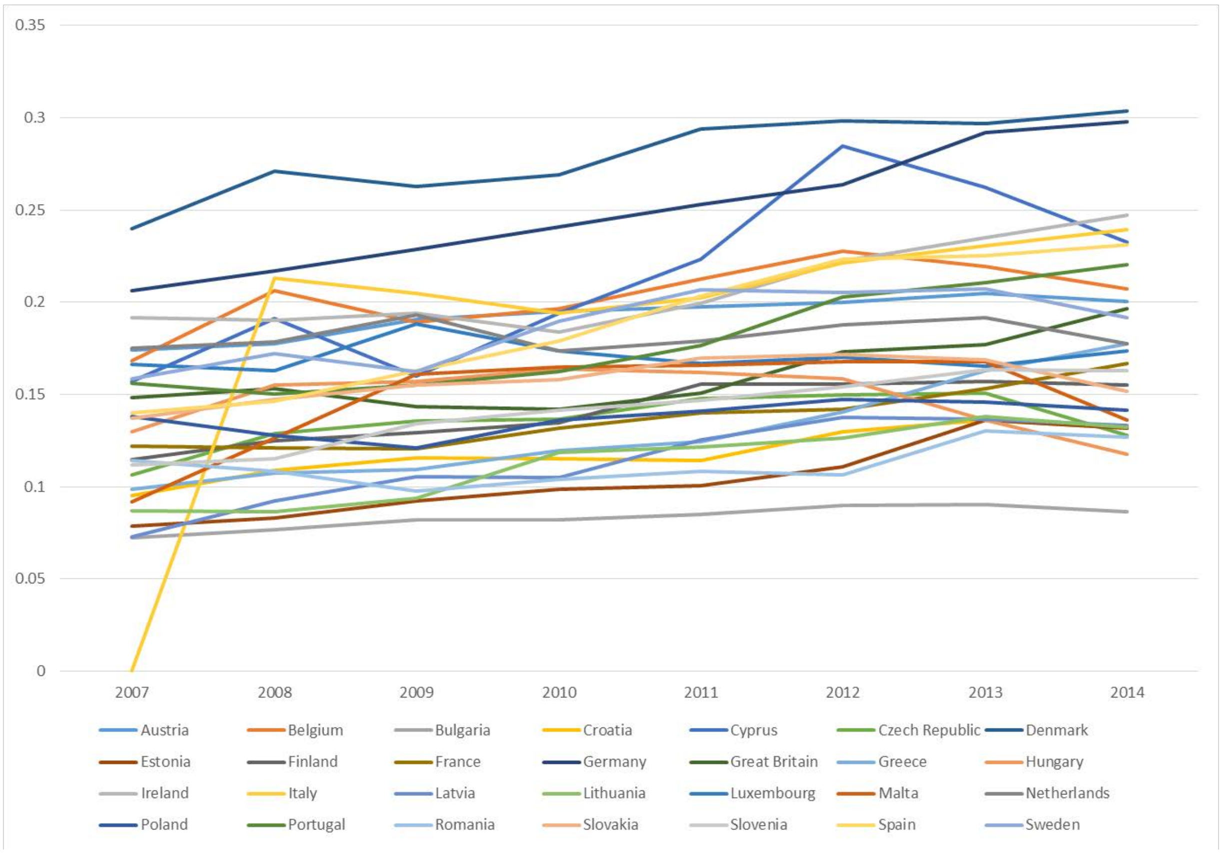
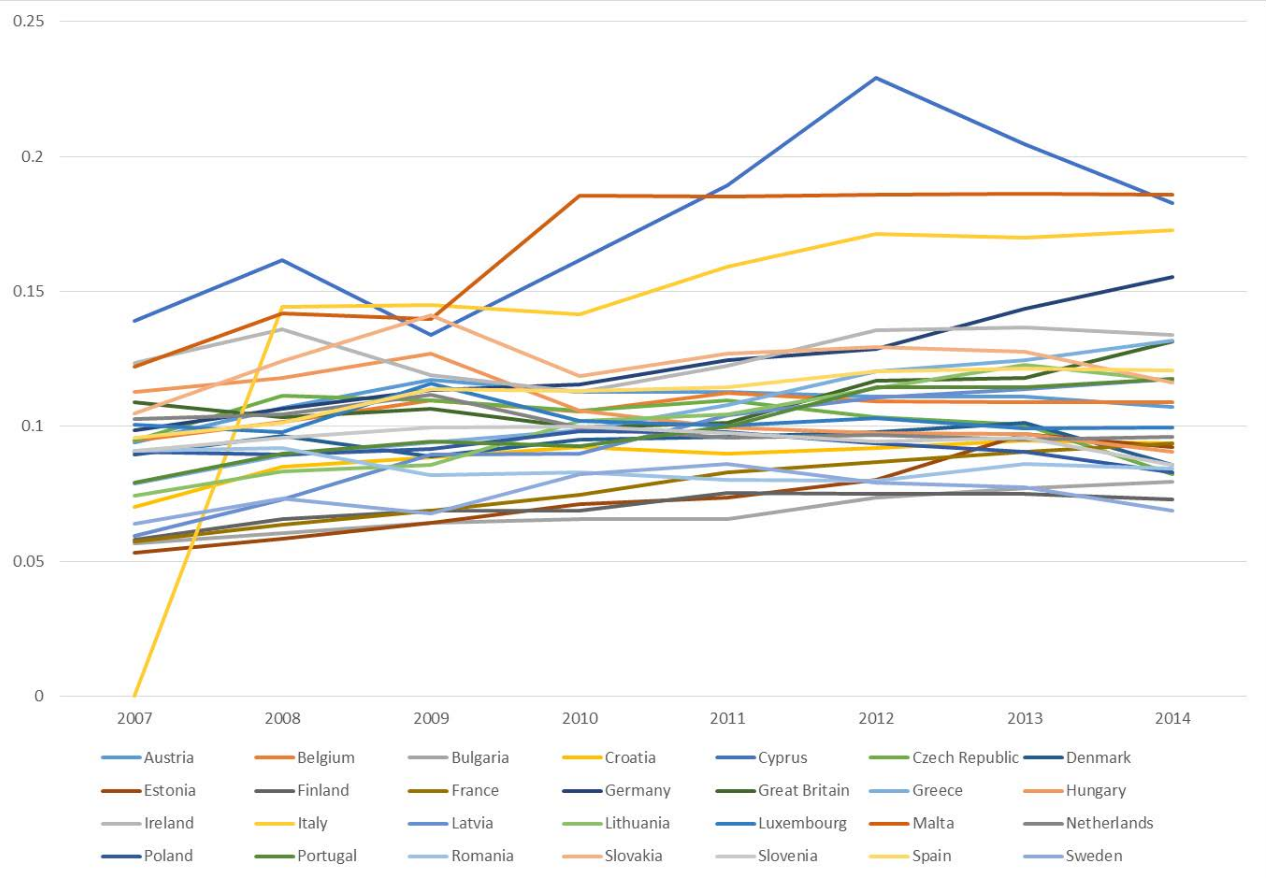


Figure A2.2 Retail electricity prices – industrial customers



A2.2 EU Gas market – time trends

Table A2.3 Market concentration over time – EU average (standard deviation across Member States in brackets)

Year	Production (CR3 gas shippers)	Retail (CR3)
2000	n.a.	n.a.
2001	n.a.	n.a.
2002	n.a.	n.a.
2003	n.a.	n.a.
2004	97.56 (6.13)	89.86 (14.38)
2005	97.32 (5.99)	81.08 (25.27)
2006	92.95 (17.71)	83.36 (22.51)
2007	85.74 (22.29)	83.62 (23.1)
2008	88.52 (15.24)	80.28 (24.08)
2009	88.5 (15.94)	81.01 (19.7)
2010	87.85 (14.06)	82.33 (18.41)

Year	Production (CR3 gas shippers)	Retail (CR3)
2011	86.48 (14.94)	78.98 (19.08)
2012	85.54 (15.18)	77.16 (19.05)
2013	88.44 (15.65)	77.16 (17.89)

Table A2.4 Market concentration over time – by Member State

Member State	Gas shippers (CR3)		Retail (CR3, HHI time trend not available)	
	2007	Change since 2007	2007	Change since 2007
Belgium	80.00	10.00	n.a.	-22
Bulgaria	99.40	-24.30	92.3	-22.97
Cyprus	32.47	67.53	32.47	50.53
Czech Republic	100.00	-7.00	n.a.	-12.35
Denmark	n.a.	n.a.	n.a.	n.a.
Germany	n.a.	n.a.	n.a.	-38.66
Estonia	n.a.	n.a.	n.a.	n.a.
Ireland	99.00	1.00	99	-1
Greece	100.00	0.00	n.a.	n.a.
Spain	88.97	-6.97	98.5	-26.5
France	58.65	n.a.	26.3	2.2
Croatia	28.00	9.64	n.a.	n.a.
Italy	100.00	0.00	100	0
Cyprus	92.80	7.20	75	-15.7
Latvia	n.a.	n.a.	100	-34
Lithuania	86.70	-4.90	66.5	-19.7
Luxembourg	100.00	0.00	100	0
Hungary	100.00	0.00	100	0
Malta	100.00	0.00	88.5	10.5
Austria	n.a.	n.a.	n.a.	n.a.
Poland	n.a.	n.a.	100	-3
Portugal	100.00	n.a.	n.a.	-3.7
Romania	n.a.	n.a.	83	-22.64
Slovenia	74.00	n.a.	100	-14.1
Slovakia	100.00	-14.10	86	-13
Finland	100.00	-0.74	74	-4.4
Sweden	75.00	-5.00	n.a.	n.a.
The Netherlands	n.a.	n.a.	n.a.	-0.5

Figure A2.3 Retail gas prices – households

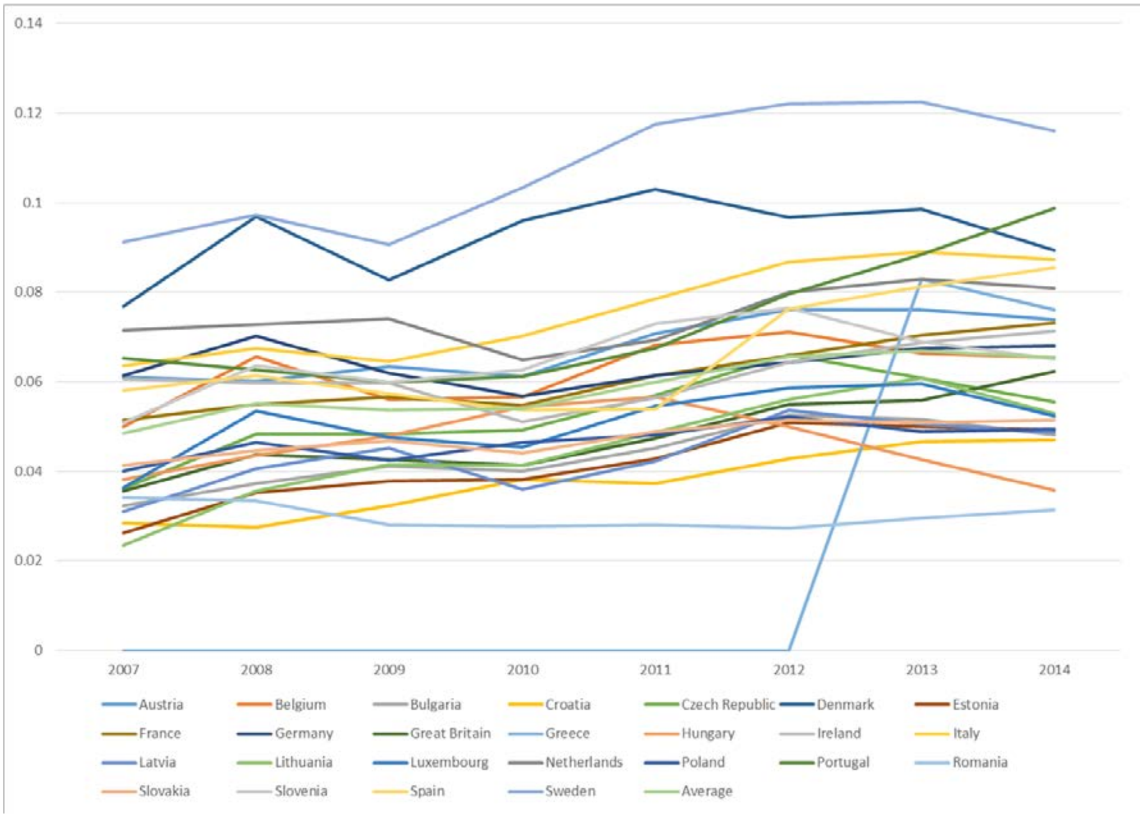
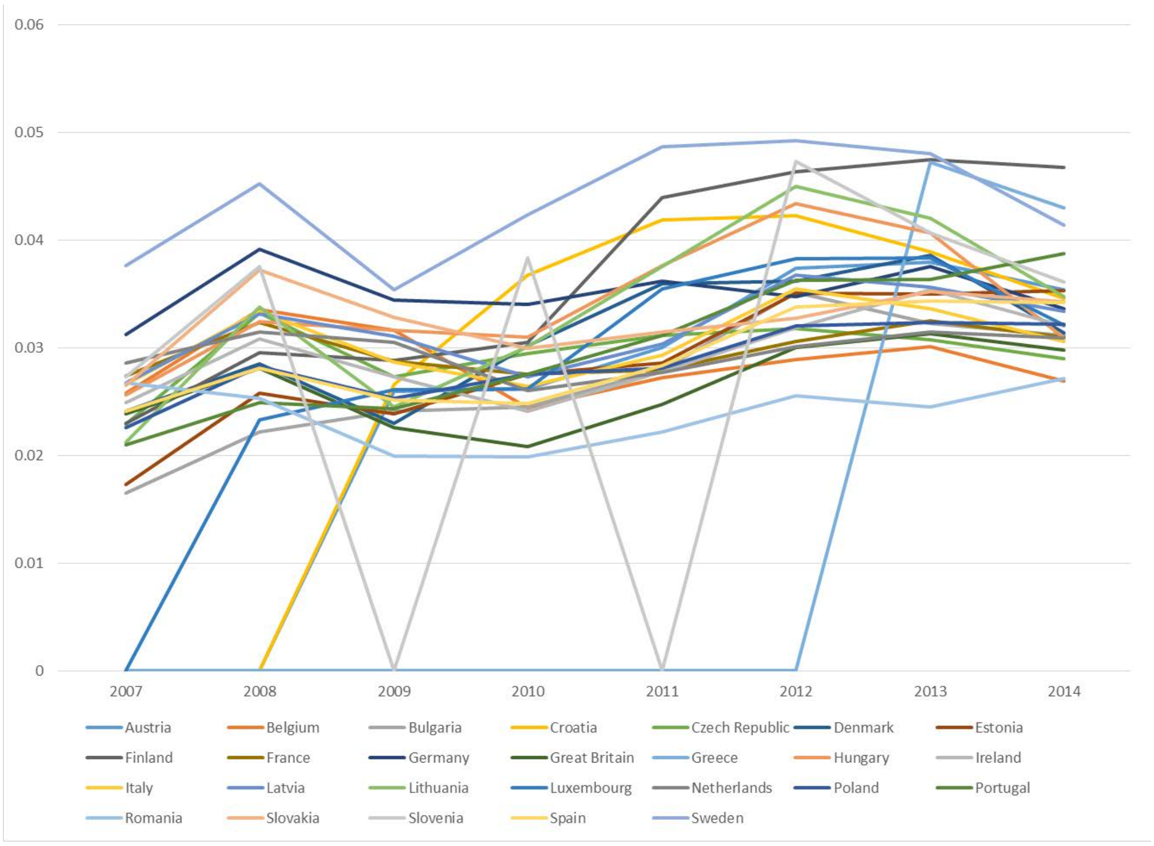


Figure A2.4 Retail gas prices – industrial customers



Annex 3 Broader econometric analysis

A3.1 Appendix 1. Estimation of total factor productivity (TFP)

We calculate total factor productivity of firm *i* in year *t* as the residual of a sector-specific (*s*), translog production function:

$$TFP_{it} = lnVA_{it} - f_s(lnK_{it}, ln\,L_{it}, ln\,M_{it}) \tag{2}$$

where VA_{it} is the value added[128] of firm *i* in year *t*, K_{it}, L_{it}, and M_{it} represent its capital (as measure by total assets), labour (as measured by staff costs) and material expenditures[129] respectively. The sector s specific production function $f_s(.)$ is a second-order translog specification (Christiansen, Jorgenson, and Lau, 1972) comprising all terms $lnK^j, lnL^j,$ and lnM^j with $j \leq 2$ (for a total of 20 terms of up to degree 6) as well as year fixed effects and firm fixed effects. This functional form can be interpreted as a second-order Taylor approximation to a general, but unknown, production function. The sector-specific production function is estimated separately for firms in electricity production, electricity transmission, electricity distribution and electricity trade, as well as for firms in gas transmission.[130] The results of the estimation in the specific sub-samples represented by the different NACE codes are reported in Table A3.1Table A3.1.

The models perform very well as they are able to explain more than 90% of the variation in the log turnover. They also produce reasonable coefficients estimate for the marginal productivities. Specifically, we can calculate the average marginal productivity for each input at the mean value of the other inputs. We estimate and average marginal productivity of labour between 0.11 and 0.36, an average productivity of materials between 0.28 and 0.55 and an average marginal productivity for capital between 0.26 and 0.45.

[128] As a proxy for value added we use the log of operating revenues which are a measure of turnover.

[129] For Denmark, Ireland and the UK no data on material expenditures are available; we proxy for these values by calculating the difference between total cost and staff expenditures.

[130] We could not estimate the function in gas production and gas trade due to the too limited number of observations.

Table A3.1 Production function regressions for the different sectors

	Electricity Production		Electricity Transmission		Electricity Distribution		Electricity Trade		Gas Transmission	
	Coeff.	**St.Er.**	**Coeff.**	**St.Er.**	**Coeff.**	**St.Er.**	**Coeff.**	**St.Er.**	**Coeff.**	**St.Er.**
lnL	0.340***	(0.090)	0.412*	(0.222)	0.809***	(0.103)	-0.163	(0.170)	-0.564	(0.382)
lnM	0.406***	(0.058)	1.018***	(0.339)	0.235***	(0.077)	0.840***	(0.057)	0.644***	(0.204)
lnK	-0.133	(0.100)	1.174***	(0.315)	-0.250**	(0.110)	0.730***	(0.137)	1.710***	(0.316)
lnL lnM	-0.043***	(0.017)	-0.117**	(0.046)	-0.215***	(0.023)	-0.079***	(0.024)	0.130*	(0.067)
lnL lnK	-0.061*	(0.033)	0.028	(0.113)	-0.127***	(0.031)	0.209***	(0.065)	0.181	(0.124)
lnK lnM	0.030	(0.023)	-0.402***	(0.113)	0.143***	(0.032)	-0.293***	(0.027)	-0.300***	(0.086)
lnL lnM2	0.005***	(0.001)	0.015**	(0.007)	0.004***	(0.002)	0.012***	(0.002)	0.006**	(0.003)
lnL lnK2	0.004	(0.003)	-0.000	(0.012)	0.003	(0.003)	-0.029***	(0.006)	-0.003	(0.013)
lnK lnM2	0.017***	(0.002)	-0.013	(0.016)	-0.012***	(0.004)	-0.026***	(0.003)	-0.008	(0.011)
lnL2	0.057***	(0.010)	-0.039	(0.043)	0.122***	(0.018)	-0.002	(0.026)	-0.166**	(0.079)
lnM2	-0.035***	(0.009)	0.112**	(0.051)	0.063***	(0.012)	0.147***	(0.010)	0.110***	(0.033)
lnK2	0.079***	(0.011)	-0.090***	(0.032)	0.069***	(0.012)	0.046**	(0.019)	-0.153***	(0.035)
lnL2 lnM	-0.007***	(0.001)	0.000	(0.011)	-0.020***	(0.003)	0.001	(0.003)	-0.003	(0.003)
lnL2 lnK	-0.002	(0.003)	0.020	(0.016)	-0.017***	(0.005)	-0.006	(0.009)	0.051**	(0.021)
lnK2 lnM	-0.009***	(0.002)	0.045***	(0.009)	-0.023***	(0.004)	0.029***	(0.003)	0.038***	(0.009)
lnL2 lnM2	-0.000	(0.000)	-0.000	(0.001)	0.001*	(0.000)	-0.001***	(0.000)	0.000	(0.001)
lnL2 lnK2	-0.000	(0.000)	-0.002	(0.002)	0.002***	(0.001)	0.001	(0.001)	-0.002	(0.002)
lnK2 lnM2	-0.001***	(0.000)	-0.001	(0.001)	0.001***	(0.000)	0.001**	(0.000)	-0.001	(0.001)
lnL lnM lnK	0.005*	(0.003)	-0.011	(0.008)	0.029***	(0.004)	0.004	(0.004)	-0.040***	(0.011)
lnL2 lnM2 lnK2	0.000***	(0.000)	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Constant	1.386***	(0.246)	0.104	(0.832)	2.562***	(0.247)	-0.942***	(0.278)	-1.562**	(0.685)
R-squared	0.952		0.991		0.986		0.947		0.960	
Obs	2,725		396		1,298		1,289		633	

The level of observation is country-firm-year. The dependent variable is the country-firm-year specific log of operating revenues. Standard errors in parentheses are robust and clustered at the country-sector level. We control for firm fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

A3.2 Appendix 2: Robustness checks for the productivity dispersion equations

As mentioned in the data section, we estimate productivity at the four-digit NACE level — i.e. electricity production, electricity transmission, electricity distribution, electricity trade, and gas transmission. Hence to provide an additional robustness check, we can also define productivity dispersion at this more disaggregated level. We report the full results in A3.2. Results are quite comparable. Specifically, we still observe a significant negative coefficient for EU merger enforcement in the low-regulation subsample.

Table A3.2 Standard deviation of TFP, full sample and low/high regulation subsamples – based on four digits NACE codes

	Full sample		Low Regulation		High Regulation	
	Coeff.	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
EU merger enforcement (lagged)	-0.055	(-1.46)	-0.091**	(-3.10)	-0.098	(-0.70)
EU State aid enforcement (lagged)	-0.028	(-0.77)	0.027	(1.01)	-0.137**	(-2.26)
EU abuse & cartel enforcement (lagged)	0.059	(0.67)	-0.062	(-0.67)	0.163**	(2.47)
National merger enforcement (lagged)	0.003	(0.07)	0.020	(0.54)	0.037	(0.47)
National cartel fines (lagged)	0.005	(0.16)	-0.051	(-1.13)	-0.017	(-0.46)
National abuse & cartel enforcement (lagged)	0.057	(0.68)	0.090	(0.70)	0.078	(0.54)
Sector Inquiry (elect. production)	-0.006	(-0.20)	0.012	(0.22)	-0.003	(-0.15)
Sector Inquiry (elect. transmission)	0.060	(0.99)	0.069	(0.70)	0.066	(0.64)
Sector Inquiry (elect. distribution)	-0.007	(-0.18)	0.007	(0.06)	0.013	(0.16)
Sector Inquiry (elect. trade)	0.040	(0.86)	0.133	(1.22)	0.018	(0.25)
Sector Inquiry (gas transmission)	-0.063	(-0.39)	-0.451	(-0.65)	-0.016	(-0.08)
Regulation (OECD index) (lagged)	-0.057	(-0.67)	-0.129*	(-1.94)	0.261	(1.20)
EU merger cases (lagged)	0.105*	(2.06)	0.105	(1.56)	0.207***	(4.04)
State aid cases (lagged)	-0.046	(-0.34)	0.184**	(2.89)	-0.181	(-1.77)
National merger cases (lagged)	-0.018	(-0.17)	0.082	(1.00)	-0.108	(-0.65)
GDP per capita	1.171	(1.04)	0.400	(0.32)	0.708	(0.53)
Population growth	-0.230	(-1.52)	-0.625*	(-2.09)	0.055	(0.61)
Energy imports (% of tot. cons.)	0.099	(0.30)	0.310	(0.44)	0.336	(1.05)
R-squared	0.35		0.41		0.48	
Observations	413		206		207	

The level of observation is country-sector-year. The dependent variable is the country-sector-year specific standard deviation of total factor productivity. All policy variables are lagged one year to reduce endogeneity issues. We report standardised beta coefficients. Standard errors are robust and clustered at the country level. The t-statistics are reported in parentheses. We control for country-sector fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

A3.3 Appendix 3: Robustness checks for the investment equations

Sector Heterogeneity

There may be heterogeneity among different sectors. When separating countries based on the degree of regulatory intensity, we indeed obtain some significant heterogeneous results.

As an additional robustness check we estimated our model (7) on different sub-samples based on the same NACE codes of the analysed firms, which were used to generate the productivity measures. Specifically, we distinguish between firms active in electricity production, electricity transmission, electricity distribution, electricity trade, as well as gas transmission. The full results are reported in Table A3.3.

Table A3.3 Investment by different NACE codes

	Electricity Production	Electricity Transmission	Electricity Distribution	Electricity Trade	Gas Transmission
EU merger enforcement (lagged)	0.005	0.202*	0.013	-0.005	0.087
	(0.20)	(1.95)	(0.26)	(-0.11)	(0.58)
EU State aid enforcement (lagged)	0.014	-0.031	0.005	-0.019	-0.000
	(0.73)	(-0.63)	(0.26)	(-0.45)	(-0.00)
EU abuse & cartel enforcement (lagged)	-0.066	0.133	-0.028	0.036	-0.118
	(-1.05)	(0.95)	(-0.30)	(0.55)	(-0.85)
National merger enforcement (lagged)	-0.033	0.105	0.075*	0.017	0.003
	(-1.07)	(0.74)	(1.98)	(0.69)	(0.17)
National cartel fines (lagged)	0.016	0.008	0.000	0.049	0.027
	(0.64)	(0.16)	(0.01)	(1.43)	(1.39)
Sector Inquiry	0.013	0.005	-0.084	0.122	-0.079
	(0.46)	(0.06)	(-0.87)	(0.86)	(-0.46)
Regulation (lagged)	0.067	-0.846**	0.759	-0.074	0.666
	(0.99)	(-2.35)	(1.54)	(-0.24)	(1.10)
EU merger cases (lagged)	0.052	-0.023	0.068	-0.043	-0.022
	(0.75)	(-0.17)	(0.99)	(-0.83)	(-0.40)
State aid cases (lagged)	0.018	0.087	-0.092	0.008	-0.062
	(0.96)	(0.97)	(-1.20)	(0.10)	(-0.60)
National merger cases (lagged)	0.024	-0.085	0.047	-0.113	-0.084
	(0.30)	(-0.30)	(0.32)	(-0.53)	(-0.73)
National cartel cases (lagged)	0.028	-0.005	-0.033	0.006	0.036
	(1.07)	(-0.04)	(-0.36)	(0.08)	(0.41)
Electricity capacity (combustible)	-0.198	0.359	2.197	-0.043	0.634
	(-0.31)	(0.22)	(1.40)	(-0.07)	(0.56)
Electricity Capacity (nuclear)	-0.142	4.565	-0.997	0.658	-0.254
	(-0.63)	(0.86)	(-1.49)	(0.67)	(-0.28)
Electricity Capacity (renewable)	0.046	0.306	-0.722	0.296	-0.298
	(0.25)	(0.75)	(-1.17)	(1.22)	(-0.49)
GDP per capita	-0.108	-1.505	0.372	-0.365	0.610
	(-0.47)	(-1.35)	(0.41)	(-0.99)	(0.63)
Population growth	0.025	0.042	0.307***	-0.023	0.107
	(0.66)	(0.20)	(3.15)	(-0.36)	(1.39)
Energy imports, % of tot cons	-0.071	0.513	-0.474	0.149	-0.146
	(-0.87)	(0.59)	(-1.66)	(0.39)	(-0.61)
R-Squared	0.02	0.19	0.20	0.14	0.12
Observations	3,388	371	1,172	1,205	658

The unit of observation is firm-country-year. The dependent variable is firm level investment. All policy variables are lagged one year to reduce endogeneity issues. We report standardised beta coefficients. Standard errors are robust and clustered at the country level are reported in parentheses. We control for firm fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

We find a positive and significant impact of EU merger enforcement in electricity transmission as well as a positive and significant impact of national merger enforcement on investment in electricity distribution. We find little evidence of a sizeable impact of competition policy on investment in other sub-markets

Autoregressive investment equation

When we use investment as a dependent variable, we also estimate an autoregressive model as a robustness check where we add the lagged dependent variable as an additional regressor. This augmented model allows us to more carefully specify the investment process, which is often characterised by inertia. Results are comparable to those obtained in the main specification. The coefficient estimate for lagged investment is not significantly different from zero, casting doubts on the fact that this model is more appropriate in our context.

Table A3.4 Investment with lagged investment, full sample and low/high regulation subsamples

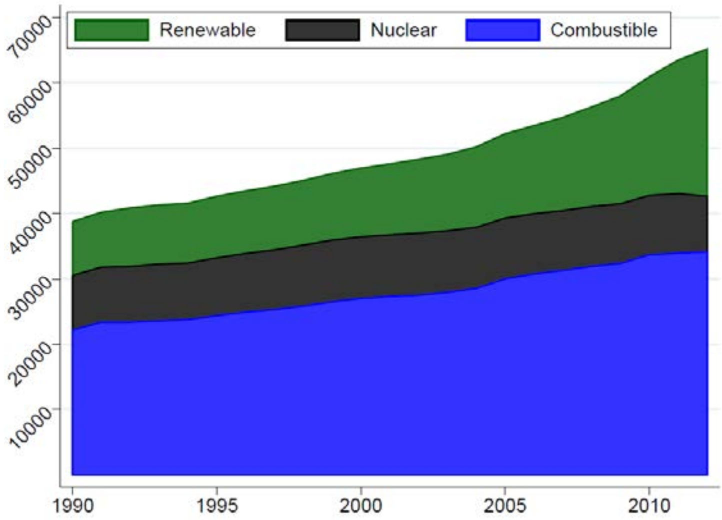
	Full Sample		Low Regulation		High Regulation	
	Coeff.	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
Investment (lagged)	-0.010	(-0.10)	-0.019	(-1.13)	0.006	(0.32)
EU merger enforcement (lagged)	-0.007	(-0.31)	0.258***	(3.16)	-0.005	(-0.16)
EU State aid enforcement (lagged)	-0.000	(-0.00)	-	-	-0.006	(-0.24)
EU abuse & cartel enforcement (lagged)	0.011	(0.30)	-0.277***	(-2.62)	0.048*	(1.75)
National merger enforcement (lagged)	0.012	(0.47)	0.016	(0.39)	0.010	(0.47)
National cartel fines (lagged)	-0.001	(-0.02)	-0.010	(-0.08)	-0.017	(-0.92)
Sector Inquiry	0.075	(1.22)	-0.031	(-0.34)	0.076	(1.43)
Regulation (lagged)	0.089	(0.96)	3.093***	(3.50)	0.059	(0.56)
EU merger cases (lagged)	-0.037	(-1.30)	-0.412***	(-3.02)	-0.093	(-1.55)
State aid cases (lagged)	0.024	(1.55)	0.221***	(2.62)	0.021	(0.73)
National merger cases (lagged)	0.041	(0.78)	-0.326	(-0.93)	0.017	(0.18)
National cartel cases (lagged)	0.038	(1.27)	0.001	(0.01)	0.084	(1.44)
Electricity capacity (combustible)	-0.606	(-1.59)	-0.580	(-0.82)	-0.529	(-1.18)
Electricity Capacity (nuclear)	-0.510	(-1.15)	11.679***	(4.24)	1.210	(0.36)
Electricity Capacity (renewable)	0.346**	(2.71)	1.134***	(3.14)	0.251*	(1.78)
GDP per capita	-0.694**	(-2.77)	-0.763	(-1.54)	-0.486	(-1.12)
Population growth	0.090*	(2.08)	0.707***	(5.51)	0.027	(0.62)
Energy imports, % of tot cons	0.077	(0.57)	0.433	(1.25)	0.208	(0.90)
R-squared	7696		3797		3899	
Observations	0.170		0.194		0.206	

The unit of observation is firm-country-year. The dependent variable is firm level investment. All policy variables are lagged one year to reduce endogeneity issues. We report standardised beta coefficients. We control for firm fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

An alternative definition of investment: Country-specific electricity capacity investment

As we mention in the data section, the chosen monetary measure of investment has some clear advantages but also the main disadvantage that we do not exactly know which kind of investment we are measuring. Hence as a robustness check, we collected information on an additional investment variable based on production capacity in electricity markets which is calculated at the (market)-country level. We collected publicly available information on generation capacity in electricity markets as published in the Country fact sheet by DG Energy that measure energy production capacities from combustible fuels, nuclear fuels and renewable fuels separately. Table A3.5 illustrates the evolution of aggregate European capacity from 1990 to 2013.

Table A3.5 Aggregate European energy production



Source: DG ENER country factsheets

In the regressions we use the change in aggregated generation capacity in each country from one year to the next.[131] The advantage of this variable is that it represents a very clean measure of specific investment. The disadvantage is that data are only available at country level and that it only covers a small part of energy markets, i.e., electricity generation.[132] Hence, the results obtained with it can only be partially compared to those obtained with firm-level data and these measures should rather be considered as complementary.

Table A3.6 reports the coefficients' estimates representing the impact of competition policy measures on production capacities in the full sample, as well as in low- and high-regulation samples. To increase the efficiency of our estimates and since we have three different measures of capacity (combustible, nuclear, renewable), we pooled them into a single regression. Therefore for each year and country, we have three observations.[133]

[131] In the main regressions we pool all capacities for the sake of econometric efficiency. The results from these regressions are only reported in the appendix.

[132] Unfortunately, there is no publicly available data on infrastructure investment for the period of interest of this study.

[133] Most of the results obtained in this specification are however driven from the effects of the policy on capacity investment in renewable energies. Indeed, if we ran the same set of regression only using the data for renewable only, we obtain similar results on the full sample. However due to the limited number of observations, we cannot run reliable regressions on the sub-sample of low- and high-regulated countries.

Table A3.6 Country-level capacities, full sample and low/high regulation subsamples

	Full sample		Low Regulation		High Regulation	
	Coeff.	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
EU merger enforcement (lagged)	-0.021	(-0.61)	-0.043	(-0.75)	0.041	(0.51)
EU State aid enforcement (lagged)	0.056	(1.16)	0.090	(1.22)	-0.017	(-0.55)
EU abuse & cartel enforcement (lagged)	0.135***	(3.19)	0.134**	(2.59)	0.242**	(2.86)
National merger enforcement (lagged)	-0.025	(-0.83)	0.046	(1.37)	-0.102**	(-2.91)
National cartel fines (lagged)	0.026	(0.68)	0.092***	(3.65)	-0.039	(-1.31)
National abuse & cartel enforcement (lagged)	0.116	(1.24)	0.122**	(2.68)	-0.120	(-1.31)
Sector Inquiry (Combustible)	-0.119	(-1.46)	-0.145	(-1.24)	-0.283*	(-1.79)
Sector Inquiry (Nuclear)	-0.204**	(-2.20)	-0.272*	(-2.08)	-0.326*	(-2.15)
Sector Inquiry (Renewable)	-0.111	(-1.35)	-0.144	(-1.24)	-0.245*	(-2.03)
Regulation (OECD index) (lagged)	-0.076	(-0.50)	0.351	(1.57)	-0.002	(-0.02)
EU merger cases (lagged)	0.270**	(2.20)	0.320**	(2.51)	0.413**	(2.31)
State aid cases (lagged)	-0.019	(-0.46)	-0.031	(-0.54)	-0.050	(-0.75)
National merger cases (lagged)	-0.083	(-0.51)	-0.184	(-1.09)	0.117	(1.54)
GDP per capita	0.141	(0.26)	-0.405	(-0.61)	1.567*	(2.14)
Population growth	0.087	(1.14)	0.226**	(2.81)	0.018	(0.18)
Energy imports (% of tot. cons.)	0.062	(0.53)	-0.550	(-1.40)	-0.127	(-0.40)
R-squared	0.39		0.43		0.45	
Observations	411		204		207	

The dependent variable is the change of energy capacity for the different production sources (combustible, nuclear, renewable). We report standardised beta coefficients. Standard errors are robust and clustered at the country level. We control for country fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

In contrast to the firm-level sample, we estimate a significant impact of the enforcement of EU as well as national abuse and cartel policies. Specifically, the number of abuse and cartel cases at the EU level significantly increase investment in capacity in the full sample, as well as in both sub-samples. A standard deviation increase in merger notifications implies 0.13 standard deviations increase in capacity investment for the full sample and the low-regulated markets sub-sample and 0.24 standard deviations increase for high-regulated markets. Moreover in the case of national cartel and abuse cases as well as fines, we estimate positive and significant effects on investment in low-regulated markets.

An additional effect that we did not observe in the main specifications is found for the Sector Inquiry. It significantly decreased investment in electricity capacity especially for nuclear capacity both in low- and high-regulated industries as well as for combustible and renewable capacities in high-regulated industries.

A3.4 Appendix 4: Robustness checks for the TFP equations – Sector heterogeneity

Similarly as above as an additional robustness check, we run our regression separately in the different sectors based on the NACE codes. We report the results in Table A3.7.

Similarly as above, we again find that the effect of EU merger control on productivity solely comes from the electricity transmission sectors. Moreover, we also observe a negative impact of state aid schemes but also of state aid control on productivity in electricity production and transmission. This additional result suggests that state aid schemes have indeed a negative impact on market outcomes and that state aid enforcement does not seem to be enough to counterbalance these effects. Finally, we also find a positive effect of national merger enforcement on productivity in gas transmission, a positive effect of national cartel investigations on productivity in electricity transmission and a negative effect of national cartel fines on productivity in electricity trade.

Table A3.7 TFP levels by different NACE codes

	Electricity Production	Electricity Transmission	Electricity Distribution	Electricity Trade	Gas Transmission
Leader Productivity	0.037	0.105	0.059	0.006	-0.499
	(0.27)	(1.69)	(0.42)	(0.16)	(-0.78)
EU merger enforcement (lagged)	0.047	0.377***	0.147	0.001	0.096
	(1.07)	(5.28)	(1.66)	(0.05)	(0.86)
EU State aid enforcement (lagged)	-0.079**	-0.064*	0.024	-0.023	-0.058*
	(-2.69)	(-1.77)	(1.67)	(-0.45)	(-1.87)
EU abuse & cartel enforcement (lagged)	0.010	-0.114	-0.140	0.108*	0.039
	(0.13)	(-1.10)	(-1.45)	(2.06)	(0.65)
National merger enforcement (lagged)	-0.034	0.155**	0.000	-0.005	0.035
	(-0.97)	(2.59)	(0.01)	(-0.26)	(0.53)
National cartel fines (lagged)	0.025	0.109*	0.029	-0.017	-0.070**
	(0.48)	(1.90)	(0.51)	(-0.51)	(-2.40)
Sector Inquiry	-0.062	-0.207	-0.267	0.033	-0.050
	(-0.32)	(-1.73)	(-1.46)	(0.52)	(-0.29)
Regulation (lagged)	0.447*	-0.429	-0.551	0.010	0.919**
	(1.84)	(-0.78)	(-1.05)	(0.04)	(2.52)
EU merger cases (lagged)	0.049	-0.108	0.110	-0.043	-0.160
	(0.81)	(-1.18)	(1.15)	(-0.41)	(-1.65)
State aid cases (lagged)	-0.132***	-0.275***	-0.066	0.034	-0.001
	(-2.94)	(-3.99)	(-1.36)	(0.42)	(-0.01)
National merger cases (lagged)	-0.002	0.468*	-0.025	0.051	-0.014
	(-0.03)	(2.09)	(-0.09)	(0.38)	(-0.09)
National cartel & abuse enforcement (lagged)	-0.028	0.279**	0.083	-0.089	-0.138
	(-0.46)	(2.83)	(0.76)	(-0.91)	(-1.65)
Electricity capacity (combustible)	0.583	0.265	1.881	0.782	-1.564
	(0.65)	(0.26)	(0.94)	(1.09)	(-1.34)
Electricity Capacity (nuclear)	0.059	2.412	0.945	-9.421	-0.165
	(0.12)	(0.42)	(1.13)	(-1.30)	(-0.21)
Electricity Capacity (renewable)	-0.357	-0.093	-1.009**	0.101	0.170
	(-0.92)	(-0.31)	(-2.26)	(0.39)	(0.77)
GDP per capita	0.144	-1.087	0.561	0.465	-0.219
	(0.20)	(-1.44)	(0.62)	(0.96)	(-0.65)
Population growth	-0.107	-0.309**	-0.220	0.051	-0.026
	(-1.26)	(-2.26)	(-1.59)	(0.67)	(-0.31)
Energy imports, % of tot cons	-0.146	-0.303	0.044	-0.663	-1.478***
	(-0.59)	(-0.46)	(0.07)	(-1.44)	(-3.13)
R-squared	0.10	0.37	0.13	0.15	0.07
Observations	1844	258	872	889	442

The dependent variable is firm level total factor productivity. We report standardised beta coefficients. Standard errors are robust and clustered at the country level. We control for firm fixed-effects as well as year dummies. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

Annex 4 E.ON case study

A4.1 Appendix 1: The Difference in Difference methodology

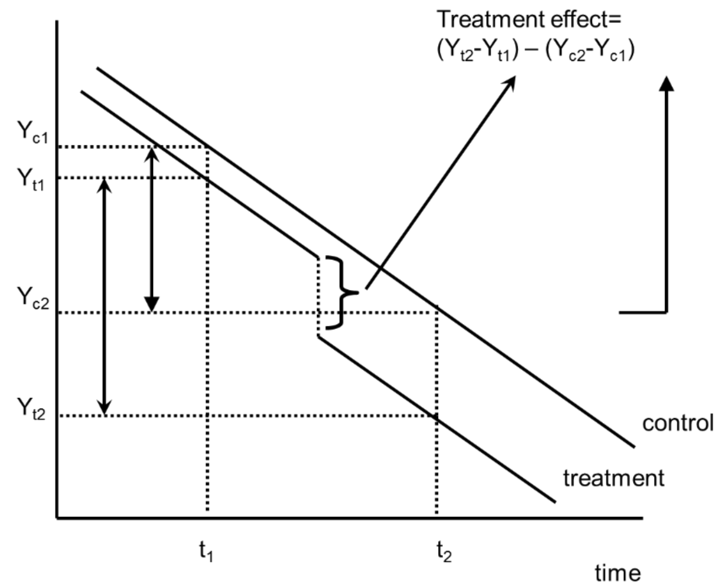
The DiD approach is probably the most popular identification strategy in applied work nowadays. It attempts to mimic the random assignment with treatment and “comparison” groups which is often used in natural sciences. One group of agents is ‘treated’ with an intervention and we have pre-post data for group receiving intervention. By examining the changes over time for an outcome variable of this group, we can measure the difference in the outcome before and after the intervention. However, given that other factors might have influenced the time evolution of the outcome, we are unsure how much of the change is due to these other factors and how much is due to the treatment itself. The basic idea of the DiD methods is therefore to look at the outcome of another group not affected by the treatment (the control group) and use the variation over time in its outcome variable to establish what would have occurred in the absence of the intervention. Key for the identification is of course that the control group is similar enough to the treated group so that it can be correctly used to represent the treated group in absence of the intervention. A simplified tabular description of the methodology is represented in the following table Table A4.1

Table A4.1 The Difference in Difference Approach

	Outcome before intervention	Outcome after intervention	Difference
Treated group: $_t$	Y_{t1}	Y_{t2}	$\Delta Y_t = Y_{t1} - Y_{t2}$
Control group:	Y_{c1}	Y_{c2}	$\Delta Yc = Yc_1 - Yc_2$
Difference-in-Difference			$\Delta\Delta Y_t = \Delta Y_t - \Delta Y_c =$ $= Y_{t1} - Y_{t2} - Yc_1 + Yc_2$

In most analyses using a DiD approach (as in this case), the researchers tend not to just observe the outcome before and after the intervention; rather they observe the evolution of the outcome for a longer period of time. In Figure A4.1 and Figure A4.2, we discuss the role of time and of the key assumption of a ‘common trend’ between treated and control groups in more detail. In this example, we observe the time evolution of the outcome variable for the treated group, which is decreasing over time. Moreover, we observe that between t_1 and t_2, this group is affected by a treatment.

Figure A4.1 Graphical Interpretation: DiD and Treatment Effect



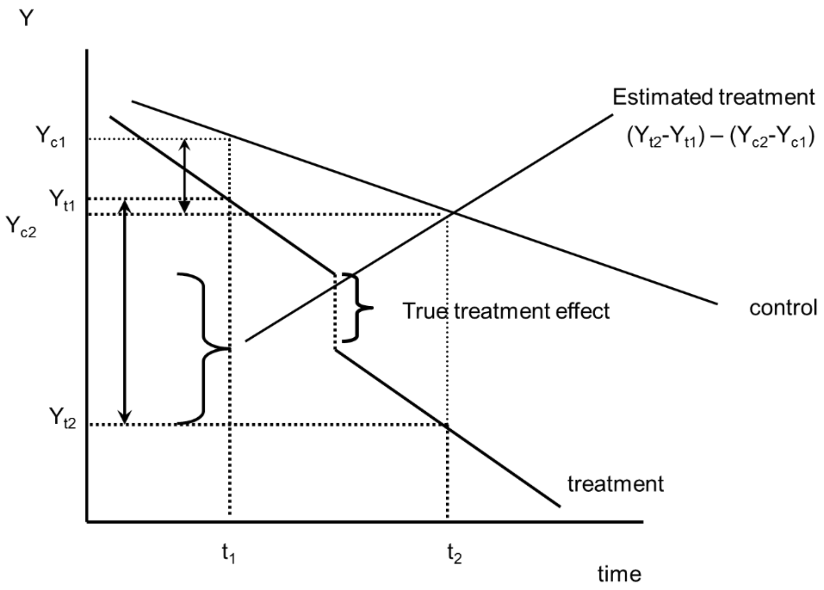
Source: Own representation

To measure the treatment effect we have to define a valid counterfactual. The control group should serve this goal by identifying the time path for the outcome that would have happened in the absence of the treatment. Specifically the outcome Y would have decreased by (Y_{c2} - Y_{c1}) even without the intervention. It is crucial to notice that the 'levels' of the outcome variable are not important because we are focusing on the difference over time for each group, therefore the group-specific time-invariant effects are levelled out. The treatment effect is identified by the different evolution over time for the outcome of the treatment group and it is represented by ($\Delta\Delta\mathbf{Y_t}$ = Yt1 - Y_{t2} - Yc_1 + Yc_2).

A key assumption for the identification of the treatment effect is that the time trends in the absence of the intervention must be the same in both groups. Indeed, if the control group has a different trend than the treated group, then the DiD method will provide a biased estimate of the treatment effect. Imagine for instance that the outcome for the treatment group decreased over time faster than for the control group, i.e. the slope of the schedule for the treatment group is steeper than for the control group (figure 1.14). In this case, the estimated treatment effect is larger than the true treatment effect.

In our specific application, the DiD method should help assess the impact of the specific competition policy intervention by comparing the outcomes (the prices) among the group mostly affected by the enforcement of the Commission's decision before and after the intervention with the outcomes of the group not affected by the intervention (the control group), over the same time period. As we mention, the two key element to the DiD method are the identification of the treated and control groups as well as the definition of the before and after periods. The DiD requires satisfying an assumption that both groups have common characteristics. This means that in the absence of the policy intervention, all other time-varying factors would affect the treatment and control groups in the same way. This is the reason why the challenge for a successful DiD design is the identification of a control group, i.e. the choice of a group which has not been affected by the policy intervention, but resembles the characteristics of a group that has been. Hence, the choice of the control variables is also very important as we want to condition out as many observable characteristics as possible that differentiate the different groups.

Figure A4.2 Graphical Interpretation: Biased Treatment Effect



Source: Own representation

We will adopt this basic methodological approach in both our case studies. However, a key element of each of the proposed analyses will be the choice of the appropriate control group and before-and-after periods.

A4.2 Appendix 2: Robustness Checks for the Wholesale market

Table A4.2 The Effect of the Divestitures on German Wholesale Prices – Full specification

	Post 2010	Post 2009	Short-Run	Single Div.
Peak	30.84***	31.03***	19.68***	19.83***
	(1.89)	(1.79)	(1.00)	(1.03)
Peak × Post	-15.37***	-14.58***	-3.22**	
	(1.65)	(1.66)	(1.54)	
Peak × Div. 1				-2.48
				(2.65)
Peak × Div. 2				-4.47***
				(1.62)
Peak × Div. 3				0.18
				(2.28)
Peak × Div. 4				3.57
				(3.25)
Peak × Div. 5				-2.40**
				(1.19)
Peak × Div. 6				-9.55***
				(2.16)
Peak × Div. 7				-4.37***
				(1.31)
Peak × Div. 8				-6.54***
				(2.27)
Wind capacity	-0.00***	-0.00***	-0.001***	-0.00***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Sun per day	-0.004***	-0.004***	-0.004***	-0.005***
	(0.002)	(0.002)	(0.002)	(0.002)
Installed solar capacity	-0.001***	-0.001***	-0.001***	-0.001***
	(0.0002)	(0.0003)	(0.0003)	(0.0001)
Temp offpeak	-1.05***	-1.04***	-1.23***	-1.25***
	(0.24)	(0.22)	(0.23)	(0.23)
Temp sq. offpeak	0.09***	0.08***	0.10***	0.10***
	(0.03)	(0.02)	(0.02)	(0.03)
Crossboarder offpeak	0.0005**	0.0005**	0.0005**	0.0005**
	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Crossboarder peak	-0.001***	-0.001***	-0.001***	-0.001***
	(0.0004)	(0.0003)	(0.0003)	(0.0003)
Market Coupling	2.48	3.09	3.09	3.13
	(2.34)	(2.13)	(2.42)	(2.47)
Brent	-0.02	0.02	0.03	0.03
	(0.06)	(0.05)	(0.51)	(0.05)
TTF price	1.32***	1.35***	1.34***	1.33***
	(0.2)	(0.13)	(0.14)	(0.14)
Uranium price	-0.31***	-0.24***	-0.24***	-0.25***
	(0.07)	(0.06)	(0.08)	(0.08)
EUA price	0.80***	0.54***	0.53***	0.56**
	(0.27)	(0.18)	(0.19)	(0.23)
coal_price	0.10**	0.04	0.04	0.04
	(0.04)	(0.04)	(0.04)	(0.04)
Holiday	-11.54***	-11.11***	-11.07***	-10.90***
	(1.7)	(1.69)	(1.65)	(1.67)
Temp peak	-1.48***	-1.54***	-1.35***	-1.42***
	(0.34)	(0.28)	(0.30)	(0.31)
Temp sq. peak	0.07***	0.08***	0.06***	0.07**
	(0.02)	(0.02)	(0.02)	(0.02)
Tue	1.85	0.54	1.51**	0.11
	(1.15)	(0.98)	(0.43)	(1.04)
Wed	1.22	0.3	1.58**	-0.32
	(1.68)	(1.37)	(0.46)	(1.46)

Thur	2.85	0.37	2.14***	-0.27
	(2.14)	(1.78)	(0.48)	(2.11)
Fri	-2.01	-2.17	-0.13	-2.98
	(2.3)	(1.75)	(0.49)	(2.07)
Sat	-1.39	-0.78	-6.96***	-1.42
	(2.52)	(1.87)	(0.73)	(2.13)
Sun	-2.64	-1.17	-13.77***	-1.76
	(2.44)	(1.95)	(0.86)	(2.24)
Feb	-3.7	-1.74	0.45	-2.31
	(2.32)	(1.97)	(0.99)	(2.24)
Mar	4.58*	4.74**	0.11	4.31*
	(2.38)	(1.92)	(1.45)	(2.29)
Apr	8.66***	8.37***	0.20	7.87***
	(1.86)	(1.52)	(2.08)	(1.68)
Mai	1.57	1.12	-2.25	0.81
	(2.09)	(1.62)	(1.98)	(1.93)
Jun	-3.36	-4.91***	-0.84	-5.38***
	(2.54)	(1.78)	(2.07)	(1.99)
Jul	-7.09***	-5.09***	-1.23	-7.90***
	(2.74)	(1.76)	(2.21)	(2.17)
Aug			-1.82	
			(2.21)	
Sept	1.43***	1.51***	4.69**	1.51***
	(0.49)	(0.42)	(2.23)	(0.44)
Oct	1.53***	1.58***	8.27***	1.58***
	(0.53)	(0.45)	(1.62)	(0.47)
Nov	2.14***	2.13***	1.07	2.14***
	(0.54)	(0.47)	(1.86)	(0.48)
Dec	-0.06	-0.12	-5.00***	-0.12
	(0.57)	(0.48)	(1.95)	(0.49)
2009	-7.12***	-6.96***	-12.42***	-6.92***
	(0.81)	(0.72)	(3.16)	(0.73)
2010	-14.41***	-13.74***	-7.64***	-13.73***
	(0.96)	(0.85)	(1.97)	(0.86)
Constant	40.32***	38.38***	46.66***	47.89***
	(7.46)	(6.33)	(7.92)	(8.24)
Cumulative post effect	-7.09***	-11.85***	-20.06***	-20.84***
	(2.74)	(4.30)	(4.97)	(5.62)
N	2190	2916	2916	2916
Adj. R^2	0.7800	0.7900	0.7657	0.7625

The dependent variable is the daily average peak or off-peak price at the EEX power exchange. Newey-West standard errors with maximum lag order of autocorrelation equal to seven days are reported in parentheses. The symbols ***, **, * represent significance at the 15, %%, 10% levels respectively.

Table A4.3 The Effect of the Divestitures on German Wholesale Prices: Robustness check I: Newey-West max lag 1 day

	Post 2010 (1)	Post 2009 (2)	Short-Run (3)	Single Div. (4)
Peak	30.84***	31.03***	19.68***	19.83***
	(1.43)	(1.36)	(0.77)	(0.80)
Peak × Post	-15.37***	-14.58***	-3.22**	
	(1.21)	(1.21)	(1.30)	
Peak × Div. 1				-2.48
				(3.52)
Peak × Div. 2				-4.47*
				(2.69)
Peak × Div. 3				0.18
				(3.08)
Peak × Div. 4				3.57
				(3.61)
Peak × Div. 5				-2.40
				(1.78)
Peak × Div. 6				-9.55**
				(2.92)
Peak × Div. 7				-4.37**
				(2.02)
Peak × Div. 8				-6.54**
				(2.69)
Constant	40.32***	38.38***	46.66***	47.89***
	(5.33)	(4.53)	(5.16)	(5.40)
Cumulative post effect	-7.09***	-11.85***	-20.06***	-20.84***
	(1.98)	(3.24)	(3.51)	(4.00)
N	2,190	2,916	2,916	2,916
Adj. R^2	0.780	0.790	0.763	0.762

The dependent variable is the daily average peak or off-peak price at the EEX power exchange. We control for input prices (gas, oil, coal, uranium, and emission), day, month, and year dummies, solar and wind energy production, cross-border production, temperature, as well as holydays. Newey-West standard errors with maximum lag order of autocorrelation equal to one day are reported in parentheses. The symbols ***, **, * represent significance at the 15, %%, 10% levels respectively.

Table A4.4 The Effect of the Divestitures on German Wholesale Prices: Robustness check II: Bootstrapped Standard Errors

	Post 2010 (1)	Post 2009 (2)	Short-Run (3)	Single Div. (4)
Peak	30.84***	31.03***	19.68***	19.83***
	(1.18)	(1.10)	(0.64)	(0.66)
Peak × Post	-15.37***	-14.58***	-3.22***	
	(0.99)	(0.96)	(1.18)	
Peak × Div. 1				-2.48
				(3.87)
Peak × Div. 2				-4.47
				(2.92)
Peak × Div. 3				0.18
				(3.45)
Peak × Div. 4				3.57
				(3.90)
Peak × Div. 5				-2.40
				(2.01)
Peak × Div. 6				-9.55***
				(3.38)
Peak × Div. 7				-4.37
				(2.68)
Peak × Div. 8				-6.54***
				(2.50)
Constant	40.32***	38.38***	46.66***	47.89***
	(4.24)	(3.80)	(4.18)	(4.43)
Cumulative post effect	-7.09***	-11.85***	-20.06***	-20.84***
	(1.57)	(2.67)	(2.82)	(3.17)
N	2190	2916	2916	2916
Adj. R^2	0.780	0.790	0.763	0.763

The dependent variable is the daily average peak or off-peak price at the EEX power exchange. We control for input prices (gas, oil, coal, uranium, and emission), day, month, and year dummies, solar and wind energy production, cross-border production, temperature, as well as holydays. Bootstrapped standard errors with 1000 replications are reported in parentheses. The symbols ***, **, * represent significance at the 15, %%, 10% levels respectively.

Table A4.5 The Effect of the Divestitures on German Wholesale Prices: Robustness check III: Weekly data

	Post 2010	Post 2009	Short-Run	Single Div.
	(1)	(2)	(3)	(4)
Peak	30.28***	30.73***	19.30***	19.46***
	(2.38)	(2.25)	(1.33)	(1.44)
Peak × Post	-15.50***	-14.37***	-3.06*	
	(1.99)	(1.99)	(1.68)	
Peak × Div. 1				-2.44
				(2.28)
Peak × Div. 2				-3.96**
				(1.95)
Peak × Div. 3				-0.97
				(1.81)
Peak × Div. 4				3.59**
				(1.68)
Peak × Div. 5				0.38
				(4.58)
Peak × Div. 6				-8.14***
				(2.21)
Peak × Div. 7				-6.64***
				(1.47)
Peak × Div. 8				-8.84***
				(1.58)
Constant	35.54***	29.93***	37.89***	38.85***
	(7.51)	(5.50)	(7.11)	(7.56)
Cumulative post effect (long run)	-8.80***	-12.80***	-21.03***	-21.69***
	(3.16)	(4.75)	(6.02)	(6.77)
N	312	416	416	416
Adj. R^2	0.873	0.884	0.845	0.842

The dependent variable is the weekly average peak or off-peak price at the EEX power exchange. We control for input prices (gas, oil, coal, uranium, and emission), day, month, and year dummies, solar and wind energy production, cross-border production, temperature, as well as holydays. Newey-West standard errors with maximum lag order of autocorrelation equal to one week are reported in parentheses. The symbols ***, **, * represent significance at the 15, %%, 10% levels respectively.

A4.3 Appendix 3: Robustness checks for the retail market

Table A4.6 Incumbent's Baseline Tariff – Yearly data

	1,500 kWh		2,800 kWh		4,000 kWh		10,000 kWh	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
E.ON	1.187	(3.653)	1.958	(6.470)	7.609	(10.40)	-49.02	(40.87)
RWE	-1.540	(3.010)	-5.877	(5.238)	-3.519	(8.820)	-22.73	(27.16)
EnBW	-1.380	(3.447)	-1.626	(5.681)	20.33**	(9.629)	-12.65	(28.08)
Vattenfall	-21.62***	(3.338)	-43.57***	(5.563)			-143.2***	(27.84)
Stadtwerke	-1.129	(9.172)	5.872	(10.32)	33.67***	(12.55)	252.6***	(70.37)
Other	5.446	(3.329)	6.270	(5.544)	11.12	(9.620)	-2.711	(27.82)
E.ON × Post	4.760***	(1.187)	7.081***	(2.074)	-3.310	(2.174)	26.91***	(8.905)
RWE × Post	7.778***	(1.186)	16.05***	(2.081)	11.06***	(2.174)	54.88***	(8.991)
EnBW × Post	11.00***	(1.349)	21.13***	(2.361)	-4.276**	(2.179)	147.8***	(9.162)
Vattenfall × Post	9.118***	(1.174)	18.71***	(2.059)	14.45***	(2.160)	75.02***	(8.855)
Stadtwerke × Post	-1.705	(1.222)	-3.472	(2.135)	-15.88***	(2.258)	-15.65*	(9.192)
Other × Post	2.877**	(1.195)	2.570	(2.088)	-13.37***	(2.243)	-1.009	(8.955)
# of EIPs	0.009***	(0.002)	0.019***	(0.002)	0.0193***	(0.004)	0.056***	(0.010)
Pop. Density	0.253	(0.175)	0.809**	(0.320)	2.205***	(0.471)	3.680***	(1.163)
Share foreign	-0.086***	(0.010)	-0.113***	(0.015)	-0.206***	(0.021)	-0.259***	(0.058)
Births-deaths	-4.948	(3.206)	-7.718	(4.919)	-8.606	(6.261)	-58.68	(37.07)
# Amadeus firms	0.102*	(0.058)	0.104	(0.094)	0.0766	(0.147)	0.136	(0.353)
Constant	349.7***	(3.412)	580.2***	(5.679)	780.4***	(8.980)	1956.7***	(29.24)
Observations	40,720		40,720		40,867		40,670	
Adjusted R-squared	0.920		0.932		0.926		0.934	

The dependent variable is the price a costumer using the different consumption plans (1,500 kWh, 2,800 kWh, 4,000 kWh, and 10,000 kWh per year) would pay if she chose the incumbent's baseline tariff. The control category for the firm-type dummies is the group of independent firms. We control for 8,208 zip-code fixed effects as well as 4 year dummies. The entire implementation period (the year 2009) is excluded from the regressions. Standard errors are clustered at the zip-code level. *t* statistics in parentheses. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

Table A4.7 Overall lowest tariff

	1,500 kWh		2,800 kWh		4,000 kWh		10,000 kWh	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
E.ON	-8.613***	(0.622)					-0.890	(4.827)
RWE	2.042***	(0.303)	1.134***	(0.364)	7.902***	(0.351)	23.70***	(3.251)
EnBW	22.62***	(8.694)	-1.338	(1.523)	8.075***	(0.712)		
Vattenfall	-1.461***	(0.409)	2.467***	(0.342)	2.468***	(0.240)	-4.822	(3.014)
Stadtwerke	6.155***	(0.340)	6.356***	(1.933)	6.284***	(0.519)		
Other	-1.392***	(0.203)	1.606***	(0.335)	5.258***	(0.300)	-11.85***	(3.060)
(E.ON + RWE) × Post	0.053***	(0.004)	0.190***	(0.003)	0.201***	(0.004)	0.213***	(0.005)
EnBW × Post	-5.975*	(3.254)	-13.01***	(3.234)	15.62***	(0.549)		
Vattenfall × Post	3.913***	(1.272)	-10.14***	(0.822)	12.87**	(6.138)		
Stadtwerke × Post	-1.334	(1.225)	-2.206***	(0.758)	9.436***	(0.652)	10.85	(15.43)
Other × Post	-0.662	(1.210)	-11.21***	(0.867)	-4.904***	(1.708)	35.97***	(3.365)
# of EIPs	-0.003***	(0.0007)	-0.014***	(0.001)	-0.0187***	(0.002)	-0.009***	(0.003)
pop1: density	-0.153	(0.179)	1.128***	(0.221)	0.598**	(0.286)	-2.159***	(0.625)
pop2: share foreign	0.172***	(0.006)	0.380***	(0.010)	0.412***	(0.012)	0.071**	(0.028)
pop3: births-deaths	-2.249	(2.505)	-2.838	(3.963)	-0.266	(5.461)	-11.63	(10.54)
# Amadeus firms	0.013	(0.032)	0.044	(0.042)	0.0770	(0.056)	0.083	(0.166)
Constant	300.4***	(1.805)	419.0***	(2.390)	564.0***	(3.572)	1,344.6***	(11.00)
Observations	40,720		40,720		40,867		40,670	
Adjusted R-squared	0.834		0.774		0.857		0.911	

The dependent variable is the price a costumer using the different consumption plans (1,500 kWh, 2,800 kWh, 4,000 kWh, 10,000 kWh per year) would pay if she chose the overall cheapest tariff in her local network area. The control category for the firm-type dummies is the group of independent firms. We control for 8,208 zip-code fixed effects as well as 4 year dummies. Standard errors are clustered at the zip-code level. t statistics in parentheses. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

Table A4.8 Price dispersion (Incumbent's Baseline Tariff – Overall Cheapest Tariff) – Yearly data

	1,500 kWh		2,800 kWh		4,000 kWh		10,000 kWh	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
E.ON	5.072	(4.141)	-3.161	(6.554)	2.176	(9.407)	-33.35	(45.13)
RWE	3.599	(3.760)	-4.149	(5.262)	-2.011	(7.927)	-33.98	(30.38)
EnBW	2.447	(4.253)	-8.943	(5.854)	10.55	(9.004)	-38.71	(30.82)
Vattenfall	-28.05***	(4.180)	-23.54***	(5.738)			-127.6***	(30.65)
Stadtwerke	4.110	(7.401)	7.164	(8.832)	38.29***	(11.72)	218.1***	(57.03)
Other	7.494*	(4.173)	3.381	(5.736)	12.47	(8.952)	-9.838	(30.66)
E.ON × Post	0.229	(1.612)	3.989	(2.756)	-2.129	(2.239)	38.77***	(9.598)
RWE × Post	8.093***	(1.637)	18.55***	(2.790)	21.60***	(2.263)	109.7***	(9.687)
EnBW × Post	-2.143	(1.803)	-11.51***	(2.817)	-21.32***	(2.252)	150.5***	(9.856)
Vattenfall × Post	8.940***	(1.619)	24.21***	(2.753)	24.56***	(2.244)	104.9***	(9.666)
Stadtwerke × Post	-0.137	(1.654)	0.738	(2.815)	-5.096**	(2.327)	20.09**	(9.912)
Other × Post	3.300**	(1.628)	8.803***	(2.768)	0.999	(2.311)	36.32***	(9.679)
# of EIPs	0.013***	(0.002)	0.032***	(0.003)	0.039***	(0.004)	0.048***	(0.010)
pop1: density	-0.055	(0.220)	-0.826**	(0.355)	0.242	(0.499)	5.559***	(1.244)
pop2: share foreign	-0.223***	(0.010)	-0.463***	(0.014)	-0.574***	(0.019)	-0.168***	(0.051)
pop3: births-deaths	-4.110	(3.245)	-5.888	(5.313)	-7.385	(6.887)	-41.88	(38.83)
# Amadeus firms	0.066	(0.063)	0.046	(0.100)	-0.0212	(0.154)	0.0991	(0.374)
Constant	31.33***	(4.117)	57.41***	(5.779)	62.54***	(8.268)	204.5***	(31.93)
Observations	40,720		40,720		40,867		40,670	
Adjusted R-squared	0.948		0.930		0.904		0.887	

The dependent variable is the price dispersion within a given zip code defined as the difference between the yearly prices a costumer using the different consumption plans (1,500 kWh, 2,800 kWh, 4,000 kWh, 10,000 kWh per year) would pay if she chooe the incumbent's baseline tariff or the cheapest tariff in her local network area. The control category for the firm-type dummies is the group of independent incumbents. We control for 8,208 zip-code fixed effects as well as 4 year dummies. Standard errors are clustered at the zip-code level. *t* statistics in parentheses. The symbols ***, **, * represent 1%, 5%, and 10% significance level respectively.

Annex 5 Gaz de France and Suez case study

Table A5.1 The effects of the Commission's decision and associated remedies - full specification

Long run model	(1) 3_mth_window	(2) Newey_1	(3) Newey_7	(4) Newey_7_3mth
treat	2.921*** (0.275)	2.571*** (0.348)	2.571*** (0.572)	2.921*** (0.595)
post		9.236*** (2.750)	9.236** (4.334)	
treat_post		-2.759*** (0.351)	-2.759*** (0.577)	
Post_3mth window	5.345*** (1.867)			6.903 (4.261)
treat_post_3mth window	-3.111*** (0.278)			-3.111*** (0.599)
tempsq	0.00615*** (0.00201)	0.00576** (0.00234)	0.00576* (0.00328)	0.00615* (0.00339)
temp	-0.222*** (0.0562)	-0.202*** (0.0647)	-0.202** (0.0911)	-0.222** (0.0953)
brent_crude_spot	0.664*** (0.0526)	0.676*** (0.0639)	0.676*** (0.0895)	0.664*** (0.0928)
coal	0.0561 (0.0380)	0.109** (0.0498)	0.109 (0.0785)	0.0561 (0.0788)
power_prices	0.000215 (0.00719)	0.000333 (0.00793)	0.000333 (0.00947)	0.000215 (0.00954)
_Iday_of_th_3	0.00132 (0.238)			
_Iday_of_th_4	0.00983 (0.219)			
_Iday_of_th_5	0.0675 (0.225)			
_Iday_of_th_6	0.0254 (0.222)			
_Imonth_2	-0.301 (0.342)			
_Imonth_3	1.113*** (0.424)			
_Imonth_4	0.755** (0.302)			
_Imonth_5	1.130*** (0.331)			
_Imonth_6	1.475*** (0.370)			
_Imonth_7	1.448*** (0.374)			
_Imonth_8	1.322*** (0.407)			
_Imonth_9	1.408*** (0.413)			
_Imonth_10	1.333*** (0.450)			
_Imonth_11	0.635 (0.391)			
_Imonth_12	0.781 (0.638)			
_Iyear_2006	3.990** (1.834)			
o._Iyear_2007	-			

Long run model	(1) 3_mth_window	(2) Newey_1	(3) Newey_7	(4) Newey_7_3mth
o._Iyear_2008	-			
o._Iyear_2009	-			
o._Iyear_2010	-			
_Iyear_2011	1.558***			
	(0.253)			
3.day_of_the_week		-0.0191	-0.0191	0.00132
		(0.167)	(0.0962)	(0.0985)
4.day_of_the_week		0.00265	0.00265	0.00983
		(0.211)	(0.113)	(0.119)
5.day_of_the_week		0.0609	0.0609	0.0675
		(0.219)	(0.149)	(0.159)
6.day_of_the_week		0.0256	0.0256	0.0254
		(0.217)	(0.137)	(0.145)
2.month		-0.244	-0.244	-0.301
		(0.441)	(0.673)	(0.658)
3.month		0.578	0.578	1.113
		(0.511)	(0.741)	(0.777)
4.month		0.690*	0.690	0.755
		(0.372)	(0.535)	(0.554)
5.month		1.388***	1.388**	1.130*
		(0.406)	(0.589)	(0.607)
6.month		1.764***	1.764***	1.475**
		(0.458)	(0.665)	(0.681)
7.month		1.732***	1.732***	1.448**
		(0.464)	(0.672)	(0.688)
8.month		1.682***	1.682**	1.322*
		(0.504)	(0.724)	(0.745)
9.month		1.797***	1.797**	1.408*
		(0.507)	(0.758)	(0.788)
10.month		1.697***	1.697**	1.333
		(0.568)	(0.864)	(0.880)
11.month		1.358***	1.358*	0.635
		(0.486)	(0.734)	(0.756)
12.month		1.390	1.390	0.781
		(0.869)	(1.310)	(1.278)
2006.year		6.260**	6.260	3.990
		(2.449)	(3.885)	(3.846)
2010.year		-1.976***	-1.976***	-1.558***
		(0.375)	(0.560)	(0.500)
2011o.year		-	-	-
Constant	0.634	-3.040	-3.040	0.634
	(2.510)	(2.943)	(4.582)	(4.936)
Observations	1,744	1,873	1,873	1,744
R-squared	0.814			

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A5.2 Robustness checks on the effects of the Commission's decision

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Baseline (Robust s.e.)	Real prices	Logs	Newey-West s.e. (1 lag)	Bootstrap	1-month window	3-month window	6-month window	Weekly average
treat	2.593***	2.162***	0.068***	2.593***	2.593***	2.660***	2.930***	3.314***	2.519***
	(0.266)	(0.257)	(0.008)	(0.350)	(0.269)	(0.271)	(0.278)	(0.296)	(0.563)
post_1	1.339*	1.451**	0.040**	1.339	1.339*	1.132	-0.419	10.57***	1.102
	(0.730)	(0.702)	(0.020)	(0.921)	(0.718)	(1.035)	(1.443)	(2.731)	(1.509)
treat_post_1	-2.364***	-2.506***	-0.059***	-2.364***	-2.364***	-2.395***	-2.606***	-2.985***	-2.290***
	(0.271)	(0.262)	(0.009)	(0.357)	(0.275)	(0.276)	(0.283)	(0.301)	(0.573)
Observations	1,759	1,759	1,759	1,759	1,759	1,717	1,642	1,502	366

The dependent variable is the daily gas price at the hub. In all specifications we control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Table A5.3 Robustness checks on the effects of the 2008 events

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

VARIABLES	Baseline (Robust s.e.)	Real prices	Logs	Newey-West s.e. (1 lag)	Bootstrap	1-month window	3-month window	6-month window	Weekly average
treat	0.228***	-0.345***	0.009***	0.228***	0.228***	0.218***	0.216***	0.179***	0.229***
	(0.032)	(0.030)	(0.002)	(0.040)	(0.033)	(0.033)	(0.034)	(0.036)	(0.060)
post_2	0.255***	-0.039	0.023***	0.255***	0.255***	0.289***	0.417***	0.469***	0.291***
	(0.064)	(0.058)	(0.004)	(0.073)	(0.064)	(0.067)	(0.071)	(0.081)	(0.106)
treat_post_2	-0.319***	-0.399***	-0.022***	-0.319***	-0.319***	-0.332***	-0.377***	-0.409***	-0.330***
	(0.048)	(0.045)	(0.003)	(0.058)	(0.049)	(0.049)	(0.050)	(0.051)	(0.083)
Observations	1,660	1,660	1,660	1,660	1,660	1,618	1,540	1,402	344

The dependent variable is the daily gas price at the hub. In all specifications we control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Table A5.4 Robustness checks on the effects of 2010 events (implementation of the last of the remedies)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(9)
VARIABLES	Baseline (Robust s.e.)	Real prices	Logs	Newey-West s.e. (1 lag)	Bootstrap	1-month window	3-month window	Weekly average
treat	-0.096***	-0.750***	-0.013***	-0.096**	-0.096***	-0.098***	-0.097**	-0.105*
	(0.037)	(0.034)	(0.002)	(0.042)	(0.036)	(0.037)	(0.039)	(0.059)
post_3	0.615***	0.894***	0.029***	0.615***	0.615***	0.711***	1.175***	0.497***
	(0.090)	(0.086)	(0.005)	(0.107)	(0.088)	(0.110)	(0.209)	(0.133)
treat_post_3	-0.105**	-0.426***	0.002	-0.105**	-0.105**	-0.108**	-0.115**	-0.103
	(0.045)	(0.042)	(0.003)	(0.053)	(0.046)	(0.0463)	(0.0476)	(0.074)
Observations	1,772	1,772	1,772	1,772	1,772	1,730	1,656	364

The dependent variable is the daily gas price at the hub. In all specifications we control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

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KD-02-16-007-EN-N

doi 10.2763/55423